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Extraction of Essential Oil from Frankincense Using Steam Distillation

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Abstract: Essential oil is a volatile, aromatic, and concentrated liquid obtained from various plant base such as seeds, resins, roots, flowers, and etc. The main objective of theresearch was to extract essential oil from the frankincense boswellia sacra resins, which is available in the Sultanate of Oman in Salalah. The factors affecting the process of extraction suchas time taken, the amount of frankincense, and the quality of frankincense obtained has been studied.The composition of frankincense essential oil was analyzed using Gas Chromatography. The extraction of frankincense essential oil was done by steam distillation. The extraction process continued for 4 hrs and 40 minutes, and the final yield of essential oil was 4.9 ml. The compositions of frankincense essential oil were analyzed by Gas Chromatography instrument. The yield of oil is more when frankincense is in powder form than in granulated form. The longer the time taken in the extraction process of frankincense essential oil, the greater the quantity of the yield.

Keywords: *Frankincense, Essential Oil, Steam Distillation, Temperature*

I. INTRODUCTION

Frankincense is an oleo gum resin obtained from several species of the genus Boswellia tree which is a member of the Burseraceae family. Generally, this substance contains of about 5-9% of essential oil, 65-85% of alcohol-soluble resin, and the lasting is water-soluble gum (polysaccharidic fraction). Essential oil is the oil extracted from the specific parts of the plant such as seeds, wood, leaves and resins, not all plants with oil but some of them like grape seeds, corns and frankincenses. The process that used to extract the oil from the plant is called distillation. There are three types of frankincense sources which are Boswellia sacra, Boswellia frereana, Boswelliacarteri. Boswellia sacra is available in Oman and Yemen, Boswellia frereana is available in African and Boswelliacarteri is in Somalia. .As frankincense is one of the most famous and desirable products, it is exported to all the countries of the world.

In this work a brief summary of the findings obtained while extracting essential oil from Frankincense Boswellia Sacra resins which is common here in Oman using Steam distillation has been presented.

Frankincense essential oil could be used as add in food, or as oil massage on the skin, or substance in medicine. The objectives of the work were to extract essential oil from frankincense using steam distillation, study the parameters affecting the production process of frankincense oil andanalyze the compositions of frankincense essential oil using gas chromatography.

II. MATERIALS &METHODOLOGY

A. Materials

A large quantity of Boswellia Sacra frankincense resins that grows in Oman was brought from local markets. The experimental work was done at the Laboratory of the National University in the Engineering college campus in South Al Hail.

B. Steam distillation set up

The steam distillation apparatus(Fig 2.1) was installed by connecting components available in the laboratory. The (500ml) distillation flask is the still which will contain the frankincense sample .The condenser was connected directly to the top of distillation flask. The inlet of the condenser was connected into the cold tap water through Brake fluid hose, while the outlet of the condenser was sent to discharge.

Figure 2.1 Experimental set up

C. Extraction of frankincense essential oil

110 g of frankincense resins were ground and placed in the still along with 300 ml of distilled water. The distillation flask was well sealed with adhesive tape at the openings to avoid vapor loss. The temperature of the heater was burner was set at 160 ° C. When the contents of the distillation flask started boiling, vapors were condensed on passing through the condenser tubes. The condensate was collected in the conical flask. Two layers phases are observed in the collected condensate corresponding to the oil layer at the top and water layer at the bottom. The oil remains above the water because of the difference in their densities. After the completion of the distillation process, the layers of the condensate were separated using a separatory funnel. The quantity of the extracted frankincense essential oil was 4.9 ml.

D. Effect of state of frankincense resins on yield

Two equal amounts of frankincense of different forms were prepared and mixed with 300 ml of water. 110 g of frankincense powder were weighed and subjected to distillation device. Similarly 110 g of raw frankincense as granules of average size 0.4 mm was weighed and placed in a distillation device. The temperature was set to 160 ^{o}C, and the distillation duration was 4 hours.

E. Effect of amount of frankincense resins on yield

Tests were applied to three samples with different amounts of frankincense powder (1: 15g), (2:30g), and (3:60g). The samples were mixed with equal volumes of distilled water which were 150ml. The temperature was set to 200 ^{o}C while

the distillation process was done within two hours and fifteen minutes for each sample.

F. Effect of time taken of distillation

Three equal samples of frankincense powder (150 g) were mixed with equal amounts of water (300ml). Temperature set on 120^{o}C. The first sample was distilled for 1 hour, second for 2 hours and the third sample for 3 hours.

G. Gas Chromatography Analysis

A very small amount of frankincense essential oil was withdrawn by injection needle. Then, this sample was placed in the portion of the designated injectable which is called injection port. After thirty-six minutes, the result of analysis was obtained.

H. Test for Physical properties

The target physical properties are density, color and odor. Viscosity was examined by comparing water viscosity and frankincense essential oil density, while color and odor were examined by visual observation.

IV. RESULTS AND ANALYSIS

A. Extraction of essential oil from frankincense using steam distillation

Frankincense resins contain a small percentage of essential oil, and the method used for extraction which was steam distillation is effective and successful in extracting essential oils from any kind of plant parts. Frankincense resin consists of 5-9 % of essential oil **(Axe, 2018).**

When comparing the percentage of yield (yield%) with the study that says the frankincense resin contains about 5-9 % of essential oil there is almost correlation with the amount extracted by steam distillation.

B. Factors affecting the yield of frankincense essential oil

It was observed that the essential oil extracted from frankincense in powdered form is more than the essential oil extracted from the raw material in solid form. According to **(Kabuba, 2009)** "condition of raw material is important because some materials like roots and seeds will not yield essential oil easily if distilled in their natural state". These materials have to be crushed, powdered or soaked in water to expose their oil cells. When the frankincense is in the state of the powder, the vapor particles facilitate the loading of the frankincense essential oil particles and are also easy to evaporate and rise.

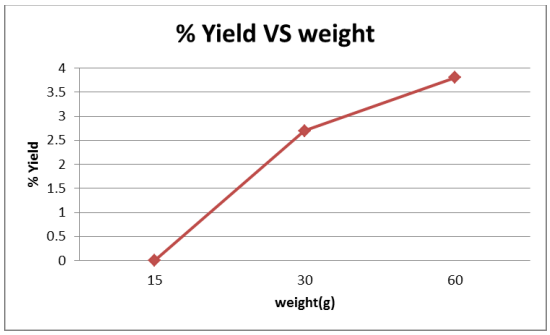

Figure 4.1 : weight of frankincense Vs % yield

The percentage of yield(Fig 4.2) of essential oil increases, as the quantity or weight of the frankincense used for distillation increases. When the amount of frankincense increases, it will also increase the proportion of frankincense essential oil extracted. The proportion of frankincense essential oil extracted from 60 g will be more than the proportion of frankincense essential oil extracted from 30 g. The smell of frankincense in the condensate serves as evidence of the presence of particles of frankincense oil there. In addition, the color of the condensate appeared to be white.

The results showed that the longer the distillation period(Fig 4.2), the higher the rate of oil extracted. According to **(Dominic, 2018)** the time taken has an effect on the yield of the steam distillation process in general.

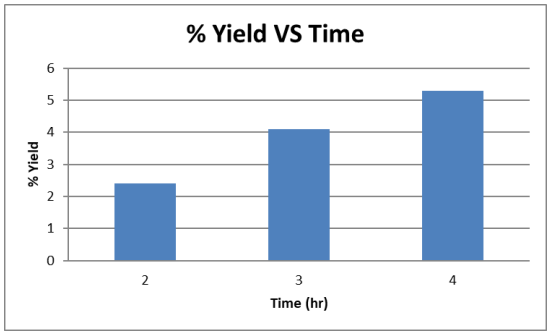

Figure 4.2: Time taken Vs % yield

The compounds found in frankincense essential oil has been shown in Fig 4.3. A-pinene shows the highest percent which is equal 48.17. According to **(Niebler, &Buettner, 2015)** There are 17 odorants components in frankincense B. Sacrewhich are a-Pinene, b-Myrcene, p-Cymene, Limonene, Eucalyptole, Carvone, trans-Carveol, Linalool, Thymoquinone, Verbenone, a-Copaene, Germacrene D, Serratol, p-Cresol, o-Methylanisole, Sotolone, and Ethyl 3-methylbutanoate.

The sample was taken from the first extraction process and the compounds found are B-pinene, a-pinene, isoterpinolene, a-phellandrene, B-phellandrene, sabinene, B-myrcene, d-limonene, cis-ocimene, n-octanol, octylformate, octyl acetate, B-citronellol, 1-decanol, and isopinocampheol.

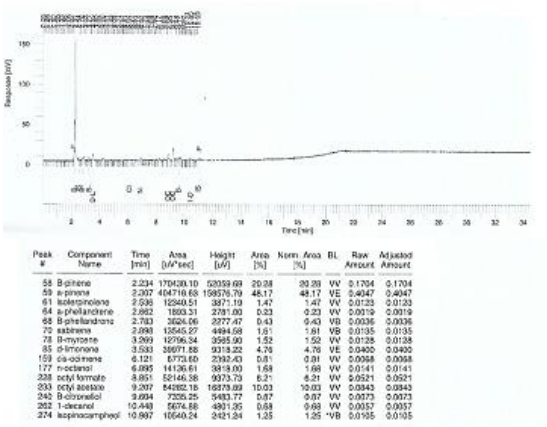

Fig 4.3 GC chromatogram for the sample

In addition, the main parameters that affecting the results are the time and temperature, the higher temperature and longer time of hydrodistillation process will produce an essential oil with high molecular weight compounds**(Suhail, 2012**).

C. Characteristics of the frankincense essential oil

The color of the frankincense essential oil was light yellow, while its aroma was beautiful and like the smell of frankincense resin spreads easily throughout the room.

It was observed that two layers were formed in the condensate as the frankincense essential oil was above the water which means density of frankincense essential oil is lighter than the density of water.

CONCLUSION

Frankincense oil is no less important than the oils that are widely distributed like coconut oil. Frankincense essential oil can be used in the cosmetic sector. The Sultanate of Oman is one of the main producers of frankincense resins, and adding it into cosmetic mixtures will be a profitable venture raising the country's economy.

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