Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.2, No.2, 2012

Evaluation of Temperature & Solvent Effect on Peach Kernel Oil Extraction & Determination & Quantification of Its Fatty

Negin Esfandiari Kahla*, AliAkbar SafeKordi

Islamic Azad University, Science and Research branch,Department of chemical engineering,Hesarrak,Tehran,Iran

* E-mail of the corresponding author: negin.esfandiari@gmail.com

Abstract

In this paper by using the most modern extraction technology, digital Soxhelet was used to extract peach kernel oil. Temperature, concentration of solvents could be adjustable by this gadget & in a controllable condition extraction could be done. Extraction was performed with Hexan & Ethanol solvents & Hexan's yield extracts were higher than Ethanol ones. To consider more, Hexan extraction was focused & with three different temperatures & 4 amounts of solvents, yield extracts were determined. As a result, increasing in temperature & concentration of solvent will lead to induction of yield extracts. In addition to digital Soxhelet extraction method, quantity of oil extraction by non-heating method (maceration in solvent) at room temperature was discussed & showed lower extraction to Soxhelet extraction. After considering amount & quantity of peach kernel oil, quality of oil was studied by defining fatty acids compositions of peach kernel oil. Using GC device, twelve fatty acids' compositions were determined. Maximum amounts were for Oleic & Linoleic acids. Finally some routine experiments were done to find out more about different values & indexes of peach kernel oil.

Keywords: oil extraction, fatty acids, Soxhelet, Gas chromatography

1. Introduction

Usage of peach kernel oil in cosmetic & hygienic products is undeniable & it is used in different creams, shampoos as rejuvenating, moisturizing, strengthening factor. In Iran, it is also used for decreasing ear aches or ear congestion traditionally. Due to this fact that quite a lot of peaches are used in juice or conserve producing industries, kernels of them are remained as waste products of the factories. Thus, to produce peach kernel oil, these waste products are useful. Peach kernel oil is odorless, yellow, non-greasy oil which can be obtained by different methods such as cold press or expeller press. This oil contains high contents of unsaturated fatty acids like Linoleic & Oleic which can help the skin preserves the moisture.

Extraction is a separation method that needs transfer from one phase to the other. Physical separation of one component from a mixture of components by solvent is called "solvent extraction" .It is even useful in purification of oil & gas & fundament of this method is the differences of solubility of one component in two insoluble solvents.

In oil extraction, physical or solvent extraction or both of them are basically used. So far for the crops with minimum 20% of oil, first physical methods like press & second solvent extraction is suggested. For the rest with less oil contents solvent extraction is more common. Factors include temperature, extraction time, solvent amount, crops are effective in the process of extraction.

In this paper, first the extraction methods of peach kernel oil & their oil contents were studied .Second determination of fatty acids & some physical & chemical properties in the peach kernel oil was focused.

Using Soxhelet device for solvent extraction is common. In this system, the oil content in different crops are solved in a proper solvent .Next the solvent is evaporated & oil can be achieved. Solvent is usually Petrolium Ether or Hexan. Due to this fact that everyday improvements of digital devices can be seen, digital Soxhelet was used in this research too.

This device can make the user sure that every safety conditions during the usage of different solvents are followed & the solvent can properly be recollected & reused completely automatically. Moreover several samples simultaneously in the individual cells were examined. The experiments were done in the controllable automated conditions to use the minimum sample & time & to reach the maximum efficiency & precision. A controller controlled all the cells so they could be adjusted for different temperatures.

Finally to determine the quality & quantity of fatty acids, having them prepared, they were injected to a gas chromatography device & the output chromatogram was saved. [1,2].

2. Materials and Methods

Oil extraction can be done by mechanical devices or by solvent. Solvent extraction was the purpose of this research and two methods of solvent extraction were studied.

Adding the solvent on the grinded crop samples, oil was solved & a two-phase mixture was made. Solvent contacted with the crop samples permanently & pull out the oil. The more usage of solvent the larger amount of oil obtained. However, the proportion of solvent should be economically logical. So the efforts are done to achieve the maximum oil extraction with the minimum solvent content.

Solvent Properties

Solvents should have these properties:

1) High solubility in low temperatures

2) Ability to solve triethyl glycerid of the crops

3) Not able to react with the extractor

4) Low viscosity to diffuse quickly in crops

5) Recycling of solvent

6) Not containing Nitrogen or Sulfur

7) Relatively stable

8) Cheap, available, non-poisonous

9) High exploding point & low boiling point

10) Non-explosive

11) Safe for the environment [3,4].

2.1 Oil Extraction by Soxhelet

By a heater, the temperature of the system was fixed.The solvent was evaporated & risen to the top side to reach the condenser. Cooling there, it was distillated & come back again in the extractor. Due to the contact with the sample, oil was extracted & when the volume of solvent in extractor reached the side pipe, it was drained & this was continued until all the oil was solved in solvent. The suggested time was four hours & after that boiling flask was taken to a vacuum rotary evaporated to evaporate its solvent & measure the remained oil inside the boiling flask.

Digital Soxehet

Since everyday new digital systems are invented, in this survey it was tried to use the new technology of digital Soxhelet.

This device ensures the user that safety conditions during the usage of different solvents are follows & the solvents can be used again. Several samples can be examined in the individual cells simultaneously to save the time. Experiments were done under controlled automated conditions to increase the precision & decrease the amount of sample .Several cells are controlled by a controller which can adjust temperatures.

Digital Soxhelets have the following advantages over the other Soxhelets:

1) Controlling the system continuously & in a steady condition that can adjust temperature & fix its condition

2) Save the time & energy

3) Possibility to examine simultaneously several samples

4) Controllable automated condition to increase precision

5) Better safety conditions

6) Recollecting the solvent so that it can be reused

7) Optimum using of input water

Factories usually use Hexane as their solvents & the extraction should be done in large scales to justify the expenses like facilities & equipments & investments. Usually oils were extracted by the press & then the residuals were contacted with the solvent. Residuals are used as animal feed. [5]

2.2 Oil Extraction by Maceration Method

A proper amount of grinded peach kernel inside a flask was contacted with a proportion of proper solvent. It was left on a shaker with 150 rpm speed for two days .Then it was put inside a centrifuge for 10 minutes with 3000 rmp speed .The solvent was evaporated in a vacuum rotary evaporator & oil content measured.

This method is used when the oil nutrition are sensitive by heat. Heat above 50°C can be considered as a degrading factor. So far extraction with Soxhelet is not suitable & it is better to use cold press or maceration methods with lower temperatures.

Determination of fatty acids compositions

To determine fatty acids & quantifying them, after preparation, samples in the form of Methyl Ester fatty acids derivatives were injected to a gas chromatograph .In a gas chromatography system “mobile” phase is a gas & “stationary” phase is a liquid which is covered on solid particles. A long steel or glass pipe was filled with the stationary phase which is called column. For this experiment, first gas current was flowing through the column continuously & the sample was injected to the device in a gas form. Sample was taken through the column with the help of carrier gas .As a result, chemical components of the sample were coming out of the column according to their properties. Basically carrier gas is chemically inert like Helium, Nitrogen, Argon, and Hydrogen. Direction of carrier gas flow was passing directly from the injection port of the sample. Prepared sample was injected by the special syringe & place called septum. Column, Injection port & detector were individually inside an oven which can adjust exact temperatures so that the samples inside the column can remain in gas phase during its movement. Generally two types of columns are used in gas chromatographs. One of them is Packed Columns which are filled by liquid stationary phase & standard diameters of them are approximately 0.5 cm & their lengths are between 1 to 20 meters. The other one is Capillary columns which the internal wall of the pipe is covered with the stationary phase. Their internal diameters are 0.25 mm & can have 10 to 100 meters lengths. Clearly the more length, the better extraction & separation yield. After passing from the column, extracted components are guided to a detector. Two common forms of detectors in this device are FID & TCC. TCC or thermal conductivity cell detector is based on thermal dependency of electrical residence of a heated wire .This detector contains a Platinum alloy wire which has an electricity flow. The rate of cooling is dependent to the amount of gas flow & thermal conductivity of the gas. Thus the carrier gas amount during the experiment is fixed only electrical conductivity of vapors changes the temperatures & residence of the wire. Organic vapors usually have less thermal conductivity in comparing with carrier gasses. Changes in the system are strengthen with an amplifier & were recorded

Amount of changes in residence is depended on amounts of organic vapors in the carrier gas. So picks in chromatograph show the contents if the special chemical components in the sample. Since this detector is not degrading the sample, it can be used where there is a need of collecting the components. FID or Flame Ion Detectors are more sensitive & have a flame to burn output organic vapors from the column. As soon as organic vapors were burnt, electrons & Ion components are produces & collected in an Ion collector device.

They produce an electrical flow that can be sent to a recorder. In this detector there is no possibility to collect the components. Ach pick represents one component from the injected mixture to the gas chromatograph that is achieved by the exit time called Retention time. Each component has different retention time & comes out of the device in a different time Here are the GC information used in the lab:

Acme 6100-Agilent with the standard of AOCS with the number of 969, 33 to prepare Methyl Ester derivatives – Capillary 100 meter column cp sill 88 with the standard cele-91 & FID (Flame Ion Detector) &temperatures of injection port 280 °C, column 198°C, Detector 240° C &-Nitrogen carrier gas with the flow rate of 14 ml/min –injection amount 1 micro liter. [6,7]

3. Results & discussion

In table 1 ,Extraction yields with three different solvents in a normal Soxhelet were achieved.

Table 1:Extraction yield in a normal Soxhelet

Oil extraction percentage	solvents
38%	n-hexan
23%	Ethanol
19%	Ethanol -H2O (v/v=50/50)

Thus Hexan solvent had more yield extract than the others, in digital Soxhelet peach kernel oil were extracted in three different temperatures & four amounts of solvents.

Table 2:extraction yields in a digital Soxhelet in 3 different temperatures & 4 different volumes of solvent

90°C temp	80 °C temp	70°C temp	Solvent volume to 5gr sample	Moisture content	solvent
32.91	25.89	19.78	50 mL(10:1)	3.56%	hexan
35.7	26.23	20.56	60 mL(12:1)	3.56%	hexan
36.21	28.24	22.30	70mL(14:1)	3.56%	hexan
38.41	29.15	26.56	80 mL(16:1)	3.56%	hexan

Since extraction in high temperature can ruin and degrade some important components in oils, with the maceration method the extraction of peach kernel oil took place.

Table3:Maceration method oil extraction yield

Oil extraction yield	Sample weigh	Solvent proportion	solvent
20%	25gr	2:1	hexan
24%	25gr	3:1	
15%	25gr	2:1	ethanol
21%	25gr	3:1	

As a result it has been seen that Soxhelet method had better extraction yield & Hexan can be a proper solvent.

Extraction yield increase with the temperature and solvent amounts. To choose the best amount and type of solvent financial conditions should be considered.

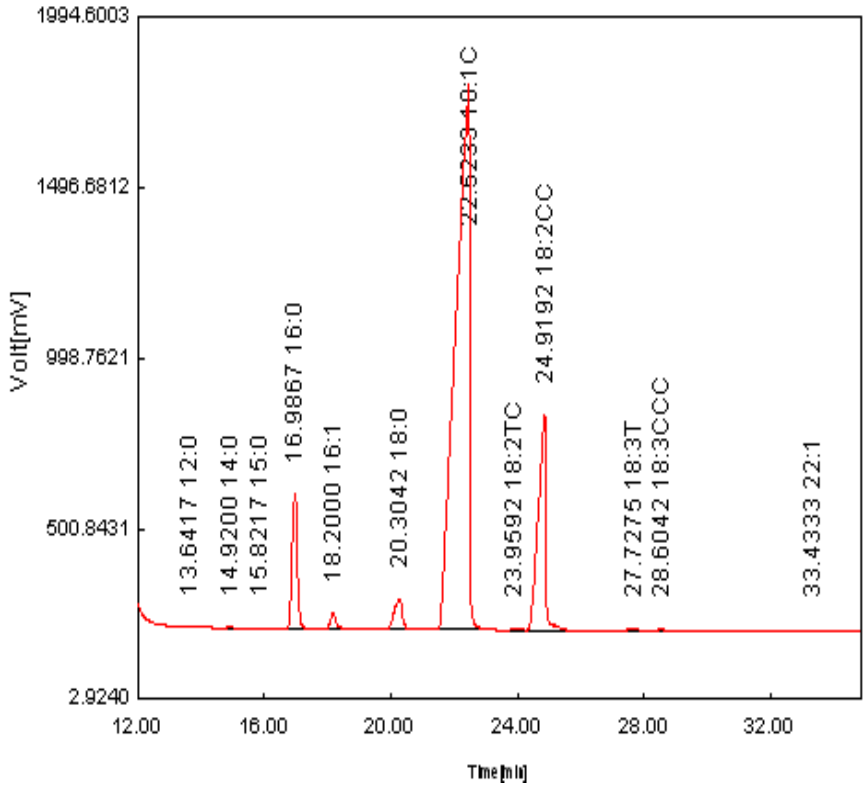

Figure 1: chromatogram of peach kernel oil

Table4: Fatty acids & their amounts in peach kernel oil

Time of out coming component	Fatty acids	Oil percentage	Molecular weight
13.6417	(Lauric) 12.0	0.0075	200.31
14.9200	(Myristic) 14.0	0.0593	228.37
15.8217	(Pentadecanoic) 15.0	0.0167	242.4
16.9867	(Palmitic)16.0	6.6869	256.4
18.2000	(Palmitoleic)16.1	0.8903	254.408
20.3042	(Stearic) 18.0	2.4863	284.48
22.5233	(Oleic)18.1	74.1780	280.5
23.9592	(Linoleic)18.2 TC	0.0533	280.95
24.9192	(Linoleic) 18.2CC	15.3628	280.45
27.7275	(Linolenic) 18.3T	0.1462	278.43
28.6042	(Linolenic)18.3CC	0.0590	278.43
33.4333	(Erucic)22.1	0.0517	388.57

According to the output chromatograph 12 fatty acids were determined & quantified .Dominant fatty acid in peach kernel oil is Oleic acid which can be very useful for humans.

4. Conclusion

Oleic acid is an unsaturated fatty acid is predominantly found in plant products and has the ability to lower blood pressure and the level of cholesterol in the body. There are many benefits of oleic acid, a few of which are listed as follows :

Oleic acid is an unsaturated fatty acid that has larger molecules which have a tendency to slide past each other without bonding with other molecules, thus ensuring free flow of blood without forming plaques that block arteries.

Oleic acid is one of the sources of good cholesterol, as it helps in lowering the total level of cholesterol in the body. It also lowers the levels of low density lipoprotein (LDL) or bad cholesterol while increasing the levels of high density lipoprotein (HDL) or good cholesterol that is required for the overall health of an individual.

Oleic acid is rich in antioxidants that help in fighting the effects of free radicals in the body. It also boosts the immune system and helps in fighting diseases by keeping us healthy throughout. It is also used as an antioxidant supplement.

It strengthens the cell membrane integrity and helps in repairing cells and tissues damage.

It boosts memory power and optimizes the functions of the brain and neurological transmission.

Oleic acid is a major ingredient in medications used for obstructing the progression of Adrenoleukodystrophy (ALD), which is a fatal disease that affects the brain and adrenal glands.

It improves the functioning of the heart and circulatory system.

Oleic acid also helps in fighting cancer and inhibits the growth of cancerous cells thus reducing the risk of

cancer, especially breast cancer. Oleic acid blocks the action of HER-2/neu, a cancer-causing oncogene found in about 30% of breast cancer patients.

Reduces the inflammation of joints and other complications related to arthritis.

Oleic acid acts as an energy booster for different functions of the body.

Mono-unsaturated fatty acids help in weight loss.

It also helps in reliving symptoms of asthma.

Reduces the clogging and hardening of arteries, also known as atherosclerosis.

Reducing the resistance of insulin thereby improving glucose (blood sugar) maintenance.

Lower the level of cholesterol in the body thereby reducing the risk of cardiovascular diseases like stroke, high blood pressure, angina pectoris (chest pain) and heart failure.

Helps in weight loss.

As an ingredient in cosmetics oleic acid acts as a moisturizer and provides soft, supple skin that glows with health. Applying oleic acid (olive oil) to the hair makes it grow thicker and stronger. [8,9].

References

[1] www.worldfood.ir

[2] Gus J. Prosch, Jr., M.D.,Dr. Arba L. Agar, Jr., Dr. S.B. Bittiner, Dr. S.S. Bleehen, "Essential Fatty Acids Are Essential", The Roger Wyburn-Mason and Jack M.Blount Foundation for Eradication of Rheumatoid Disease AKA The Arthritis Trust of America,Vernon, WA 98273, Vol. 5, No. 3, p. 23, 1994

[3] Heidari Amir,"Oil Extraction From citrus",master thesis, Sanati Sharif University ,Tehran,Iran, Sep 2002

[4] Moadab Doost Zahra,"Oil Extraction from Watermelon Seeds",master thesis,Sanati Sharif University,Tehran,Iran,Oct 2009

[5] SOXTHERM RAPID EXTRACTION, www.gerhardt.de

[6] N.Mezzomo,Bruna R. Mileo,Maria T. Friedrich,J Martinez, S.R.S. Ferreira, "Supercritical fluid extraction of peach almond oil", Process Yield & Extract Composition, Departamento de Engenharia Quimica e Engenharia de Alimentos, Universida de Federal de Santa Catarina, Brazil

[7] Ghavvami Mehrdad,Gharacholou Maryam,Ghiasi Tarazi Babak," Laboratory techniques for oils & fats", published in Islamic Azad University Science and Research Branch ,Tehran,Iran,2009

[8] Pelin Gunc Ergonul,Bulent Frganul," Changes in Fatty Acid Profiles & Omega Fatty Acid Contents of Selected Vegetable Oils during Refining Process", Electronic Journal of Environmental, Agricultural & Food Chemistry, Turkey

[9] www.buzzle.com

Negin Esfandiarikahla was born in December 1986, Tehran,Iran. She has studied chemical engineering -food industry in Islamic Azad University ,Science and Research branch in Tehran. She has completed her 4-year bachelor studying in September 2009.She continued her education in the same field and the same university for 2 years and is going to finish her master degree by the end of February 2012. She was exempted from M.S. program entrance exam as an "Exceptionally Talented" student & was top student among chemical engineering students during both her B.S & M.S study.

AliAkbar Safekordi He has got his PhD in chemical engineering from University of Manchester Institute of Science and Technology (U.K). He is a faculty member of Sharif University and Islamic Azad University Science and Research Branch in Tehran ,Iran. He is teaching Unit Operation ,Transport Phenomena, Food processing and Food Technology . His research activities are food Processing ,Mass Transfer & phenomena And Equipment Design .