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Effect of Distillation Methods on Essential Oil Yield and Composition of Basil Dried by Different Drying Systems

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Abstract

The main aim of this study is to investigate the effect of different distillation methods (water and steam) on essential oil yield and composition of sweet basil as affected by drying methods (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying). The obtained results indicated that the basil essential oil content values were 2.3 and 2.4, 2.5 and 3.4, 2.9 and 4.0, 2.7 and 2.7 and 2.0 and 2.3 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 2.60 % for fresh basil. Distillation time was ranged 165 to 180 min for all treatments. The α-pinene and β-pinene by using steam distillation higher than those α-pinene and β-pinene by using water distillation. The highest values of the linalool for water and steam distillation were 45.556 and 46.616 % was obtained when the basil dried at room temperature system. The camphor and methyl chavicol values ranged from 3.037 to 10.910 and 4.550 to 11.539 %, respectively, for all treatment. The geraniol values were 8.676 and 7.743, 4.058 and 3.372, 3.962 and 3.210, 7.884 and 5.361 and 5.138 and 3.728 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively. The eugenol and β-caryophelliene values ranged from 17.408 to 25.739 and 0.487 to 2.525 %, respectively, for all treatment. The total costs of basil essential oil production ranged from 0.87 to 1.75 LE g^{-1} of essential oil

Keywords: Basil – Sun-drying – Solar-drying – Oven-drying – Essential oil content- pinene – Linalool - cost

Introduction

Sweet basil (*Ocimun basilicum L.*) is a popular culinary herb originated in India, Africa and southern Asia and nowadays cultivated world-wide **(Putievsky and Galambosi, 1999 and Makri and Kintzios, 2007)**. Sweet basil is used extensively to add a distinctive aroma and flavor to food, such as salads, pizzas, meats and soups. It is well-known that the presence of essential oils and their composition determine the specific aroma of plants and the flavour of condiments. Essential oils of spices and/or herbs could also be used as functional ingredients **(Viuda-Martos *et al.*, 2011)**. Numerous studies have documented that sweet basil contains high concentrations of phenolic compounds (especially rosmarinic acid and caffeic acid), which are characterized by high antioxidant capacity **(Surveswaran *et al.*, 2007 and Lee and Scagel, 2009)**.

Sweet basil essential oil contains mainly monoterpenes, sesquiterpenes, alcohols, aldehydes, ketones, esters and miscellaneous compounds **(Lee *et al.*, 2005)**. The most important compounds are affected by the geographical source, for instance linalool and estragole were dominant in Egyptian sweet basil **(Karawya *et al.*, 1974)**, linalool, estragole and eugenol in Israeli sweet basil **(Fleisher, 1981)**, eugenol, methyleugenol, eucalyptol and linalool in Italian sweet basil **(Di Cesare *et al.*, 2003)** and linalool and eugenol in Spanish sweet basil **(Díaz-Maroto *et al.*, 2004)**.

The essential oil of basil consists of a wide and varying array of chemical constituents, depending on variations in chemotypes, leaf and flower colours, aroma and origin of the plants **(Sajjadi, 2006, Javanmardi *et al.*, 2003, Chalchat and Özcan, 2008 and Carovic´-Stanko *et al.*, 2010)**. Methyl chavicol, methyl cinnamate, methyl eugenol, citral, and linalool are generally the main chemotypes in basil. Investigations **(Sajjadi, 2006 and Carovic´-Stanko *et al.*, 2010)** on the chemical composition of the essential oil of basil, however, have demonstrated considerable variability. Basil has been reported to contain monoterpenoids (carvone, cineole, fenchone, geraniol, linalool, myrcene and thujone), sesquiterpenoids (caryophyllene and farnesol), a triterpenoid (ursolic acid), and a flavonoid (apigenin).

Aromatic herbs and spices are most sensitive to drying processes that increase biological deterioration. Thus, carful drying is a fundamental requirement for achieving a high quality product. Drying increases the shelf life of plants by slowing microorganism growth and by preventing biochemical reactions that can alter organoleptic characteristics **(Díaz-Maroto *et al.*, 2003**

and Hamrouni-Sellami *et al.*, 2012). Herbs and almost all vegetables and fruits are dried under sunlight because of the lower cost **(Soysal, 2004)**. Many problems in sun drying exist, such as the slowness of the process, exposure to environmental contamination, uncertainty of the weather and the extended used for manual labor **(Abdelhaq and Labuza, 1987 and Kostaropoulos and Saravacos, 1995)**. Mechanical drying can be a large expense in medicinal plant production due to investment in equipment and energy costs. In recent years, various methods, such as microwave drying and freeze-drying, have gained popularity as alternative drying methods for a variety of food products, including herbs **(Wang and Sheng, 2006)**. As of yet, no studies have documented a suitable drying method to maintain volatile oil constituents in landraces of basil.

Drying methods have a great effect on the essential oil content of basil which cause a great losses in its quality because of the unsuitable drying temperature, slowness, exposure to environmental contamination and an addition to high labor requirement, therefore, the main aim of this work is to study the effect of different drying methods on essential oil yield and composition of sweet basil to determine the best drying methods of conserving the major essential oil compounds of basil.

Materials and Methods

The experiment was carried out at Agricultural and Bio-Systems Engineering Department, Faculty of Agriculture Moshtohor, Benha University, Egypt (latitude 30° 21\` N and 31° 13\` E). During the period of June and July, 2019 season.

1.1. Materials:

The fresh basil was brought from the Faculty of Agriculture Farm, Moshtohor, Benha University after harvesting for primary analysis.

1.1.1. Drying systems:

The basil was dried using five different systems as follows:-

1- Sun-drying:

Basil leaves were folded into a thin sheet of paper and placed on a flat plate in direct sunlight. Tray with a dimension of (0.8 m long, 0.6 m wide and 0.1 m high).

2- Shadow-drying:

Basil leaves were folded into a thin sheet of paper and placed on a flat plate (0.8 m long, 0.6 m wide and 0.1 m high) in shadow.

3- Room temperature-drying:

Basil leaves were folded into a thin sheet of paper and placed on a flat plate (0.8 m long, 0.6 m wide and 0.1 m high) in room was air-drying at ambient temperature.

4- Hybrid-solar drying:

The solar collector consists of three major components, namely: The glass cover has dimensions of 4.0 m long, 1.0 m width and 5.5 mm thickness. The cover is fixed on a wooden frame with a thickness of 10 cm. It is divided into two lanes, 50 cm wide each. The absorber plate is made from corrugated black aluminum plate. The insulation is a thermal wool with a 5.0 cm thickness. The drying chamber has a length of 1.0 m, width of 0.75 m and height of 1.0 m. It is made of galvanized steel (5 mm thickness). The inner surface of drying chamber is covered an insulated materials to reduce heat loss from the walls. The trays are made of stainless steel and have a length of 0.90 m, width of 0.65 m and height of 0.25 m. They have perforated bottom which allows heated air to pass through products. Two air blowers were used to force and re-circulate the drying air to the drying chamber (Model C.C.P. Parma – Flow Rate 6.6 m^3 h^{-1} – RPM 2800 – Power 150 W, 220V 50Hz, Italy).

5. Oven-drying:

Basil plants were spread evenly on baking sheets and placed in conventional laboratory oven (Fisher Scientific Isotemp Oven, Model 655F Cat. No. 13-245-655, Fisher Scientific, Toronto, Ontario, Canada).

1.1.2. Distillation systems:

Two systems of distillation were used: water and steam distillation.

1.1.2.1. Water distillation:

The mechanism of the Clevenger apparatus is shown in Figure (1). The plant sample was placed into the round bottom flask (I part). Distilled water was poured into the Clevenger apparatus through the funnel ‘N’ until the water became equal at ‘B’ and ‘H’ points. 0.5 ml of xylene was added to the apparatus from the tube ‘K’ to entrap the extracted essential oil. When xylene is added, it flows on the water surface and during distillation, the little amount of extracted EO was collected in xylene after adding xylene, the ‘K’ part was closed with aluminum foil. Hydro-distillation was carried out for 3 hours in order to achieve maximum recovery of EO. As soon as the distillation process was completed, essential oil (EO) was collected from the ‘K2 tube by means of a glass pippet. Anhydrous sodium sulphate was then added to the mixture of essential oil, xylene, and water (H-J). Anhydrous sodium sulphate absorbed the residual water and xylene from the essential oil. Xylene also increases the yield of EO extract. EOs were then collected in glass vials, which were sealed with aluminum foil and stored in -20 ◦C to be used later.

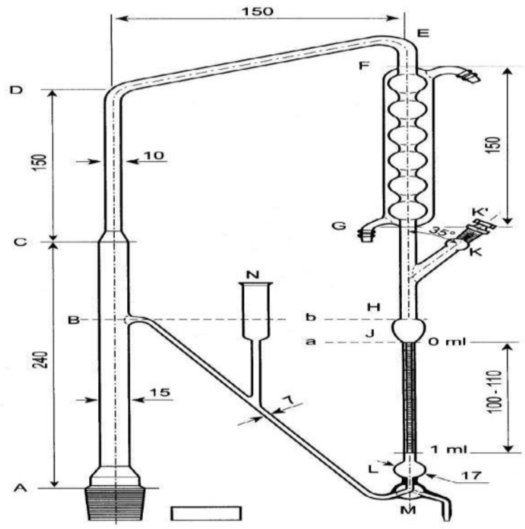
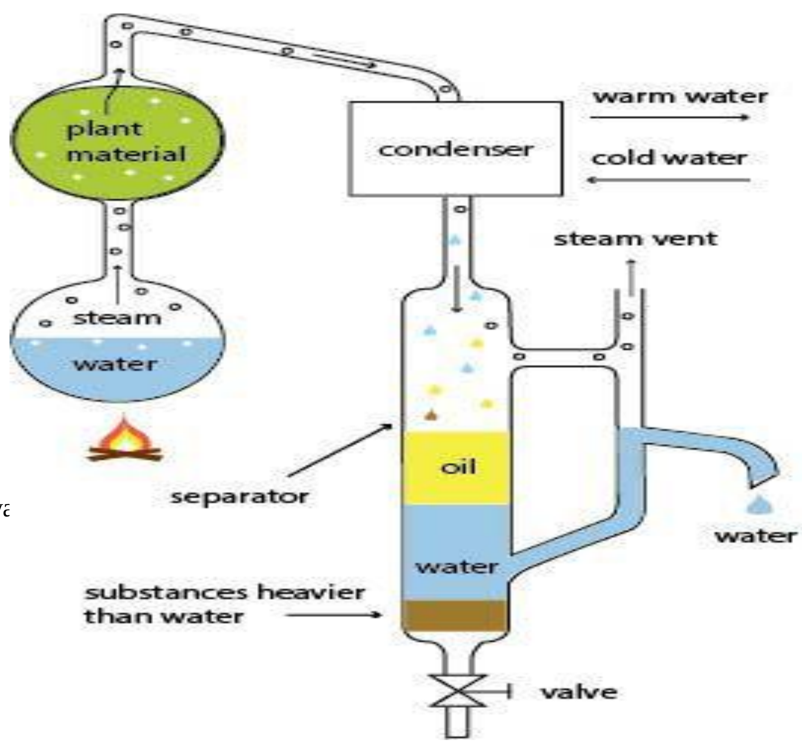


Figure (1): The water distillation system.

1.1.2.2. Steam distillation:

The distillation method in which steam with a certain amount of moisture is sprayed on the plant material placed on the grid in a similar system to water distillation and steam transfer of the essential oils is known as (Fig. 2) steam distillation. Steam distillation is essentially a process of distilling plant material with steam generated by a boiler. In this method, the material is placed on a perforated plate above the steam inlet. It is easy to control how much steam is generated in the steam generating mechanisms. Furthermore, since the steam generator is outside of the distillation unit, the ambient temperature at which the material to be distilled is located is kept below 100° C and the occurrence of impairments due to the heat effect can be prevented or reduced. The biggest problem of the steam distillation is the vapor pressure and the degradation which can occur when the flow rate is high.



1.2. Methods:

Basil wa [...] the process flow chart (figure 3).

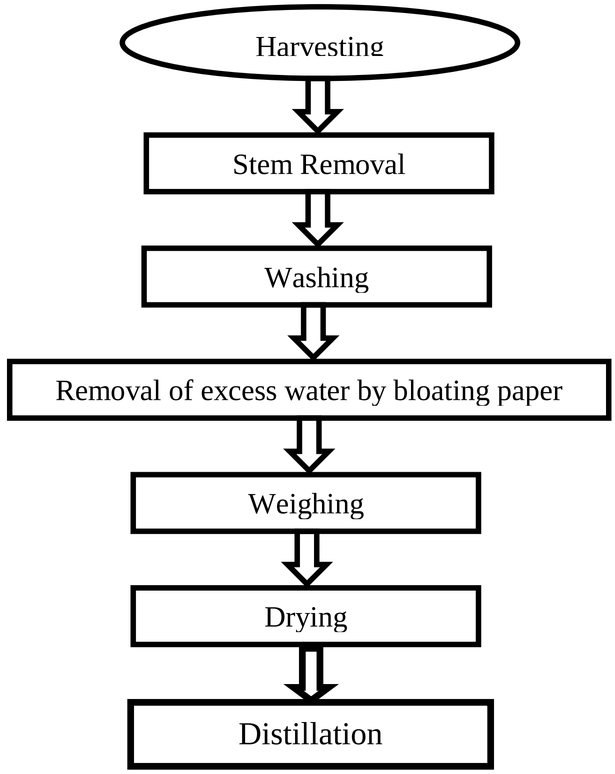


Figure (3): Flow chart of basil processing

1.2.1. Treatment:

The treatments include: two distillation methods (water and steam) and five drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying). The experimental design was a split plot.

1.2.2. Drying systems:

Five different drying systems were used to dry basil, sun-drying (35.5 ± 3.7°C and 57.5 ± 2.0 % RH), Shadow-drying (35.2 ± 2.0°C and 68.5 ± 3.0 % RH), Room temperature-drying (32.0 ± 2.0°C and 58.0 ± 4.0 % RH), Solar-drying (51.0 ± 9.0°C and 40.0 ± 13.0 % RH) and Oven-drying (65°C and 10% RH).

1.2.3. Measurements:

The mass was measured by electric digital balance (Model HG – 5000 – Range 0 - 5000 g ± 0.01 g, Japan) hourly for sun, shadow and ambient air drying methods and every 15 minutes for solar and oven drying methods. The content of essential oil was determined in basil plants according to **(Kiferle *et al.*, 2011)**. The volatile oil was analyzed using DsChrom 6200 Gas Chromatograph equipped with a flame ionization detector for separation of volatile oil constituents. The analysis condition were as follows: The chromatograph apparatus was fitted with capillary column DB-WAX 122-7032 polysillphenylene – siloxane 30 m X 0.25mm ID X 0.25µm film. Temperature program ramp increase with a rate of 13 °C min^{-1} from 60 to 220 °C. Flow rates of gases were nitrogen at 1 ml min^{-1}, hydrogen at 30 ml /min and 330ml/min for air. Detector and injector temperature were 280 and 250 ° C, respectively. The obtained chromatogram and report of GC analysis for each sample were analyzed to calculate the percentage of main components of volatile oil.

Results and Discussion:

1.3. Content of essential oil:

Figure (4) shows the basil essential oil content for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the basil essential oil content values were 2.3 and 2.4, 2.5 and 3.4, 2.9 and 4.0, 2.7 and 2.7 and 2.0 and 2.3 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 2.60 % for fresh basil. The results indicate that the highest value of the basil essential oil content for water and steam distillation (2.9 and 4.0%) was obtained when the basil dried at room temperature system. Meanwhile, the lowest value of the basil essential oil content for water and steam distillation (2.0 and 2.3 %) was found at the oven-drying system. The results also indicate that the basil essential oil content by using steam distillation more than those basil essential oil by using water distillation. These results were in agreement with those obtained by **Khater *et al.* (2019)** whose found the highest value of the basil essential oil content was obtained when the chamomile dried at room temperature system. Meanwhile, the lowest value of the basil essential oil content was found at the oven-drying system.

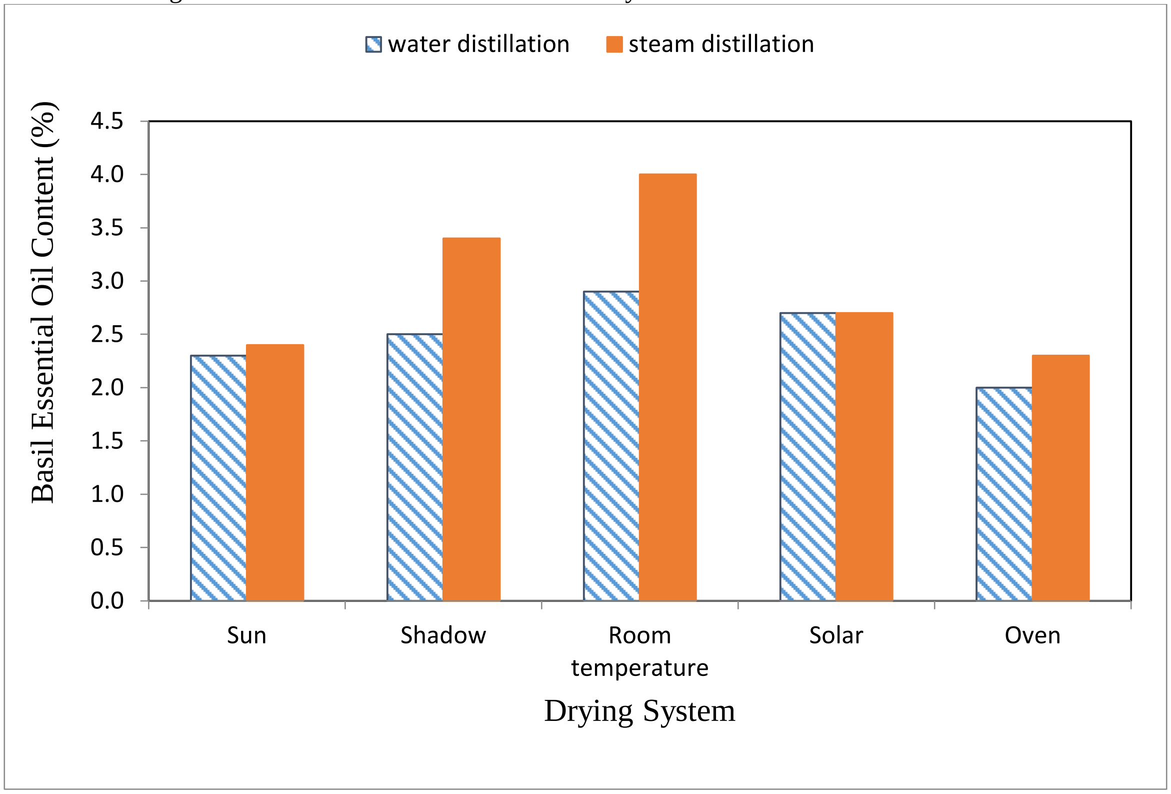
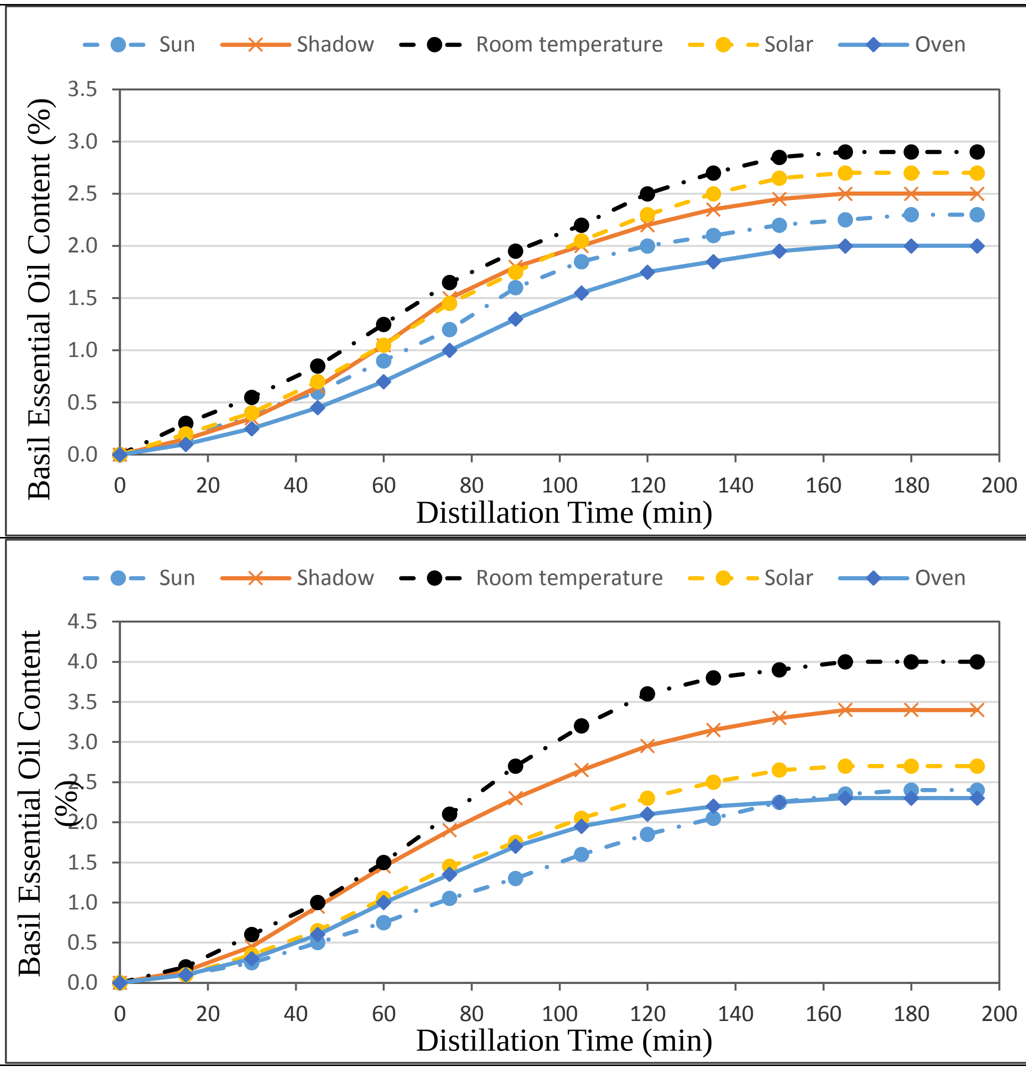


Figure (4): The basil essential oil content for different distillation methods and different drying systems.

1.4. Distillation time:

Figure (5) shows the effect distillation time on basil essential oil content for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) during experimental period. The results indicate that the basil essential oil content increased gradually until it reached the peak and then constant. It could be seen that the basil essential oil content values were 2.3 and 2.4 % for water and steam distillation, respectively, for the sun-drying after 180 min, and they were 2.5 and 3.4, 2.9 and 4.0, 2.7 and 2.7 and 2.0 and 2.3 % for water and steam distillation, respectively for the shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, after 165 min.



a

b

Figure (5): Effect of time distillation on basil essential oil content for different distillation methods and different drying systems. a: water distillation b: steam distillation

The regression between the basil essential oil content and operating time for different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) is show the following equation:

$$OC = a\,t + b \qquad (1)$$

Where:
OC is the essential oil content, %t is the operating time, min The constants of these equations and coefficient of determination are listed in table (1).

Table 1. The constants of these equations and coefficient of determination.

Drying System	Water Distillation			Steam Distillation		
	Constants		R^2	Constants		R^2
	a	b		a	b	
Sun	0.214	-0.144	0.955	0.240	-0.239	0.953
Shadow	0.256	-0.245	0.964	0.345	-0.355	0.971
Room	0.284	-0.206	0.981	0.414	-0.474	0.971
Solar	0.272	-0.288	0.982	0.277	-0.339	0.979
Oven	0.207	-0.271	0.976	0.226	-0.314	0.986

1.5. α-pinene:

Figure (6) shows the α-pinene for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the α-pinene values were 0.176 and 0.738, 0.407 and 0.779, 1.020 and 1.127, 0.618 and0.853 and 0.518 and 0.933 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 9.67 % for fresh basil. The results indicate that the highest value of the α-pinene for water and steam distillation (1.020 and 1.127 %) was obtained when the basil dried at room temperature system. Meanwhile, the lowest value of the α-pinene for water and steam distillation (0.176 and 0.738 %) was found at the sun-drying system. The results also indicate that the α-pinene by using steam distillation higher than those α-pinene by using water distillation.

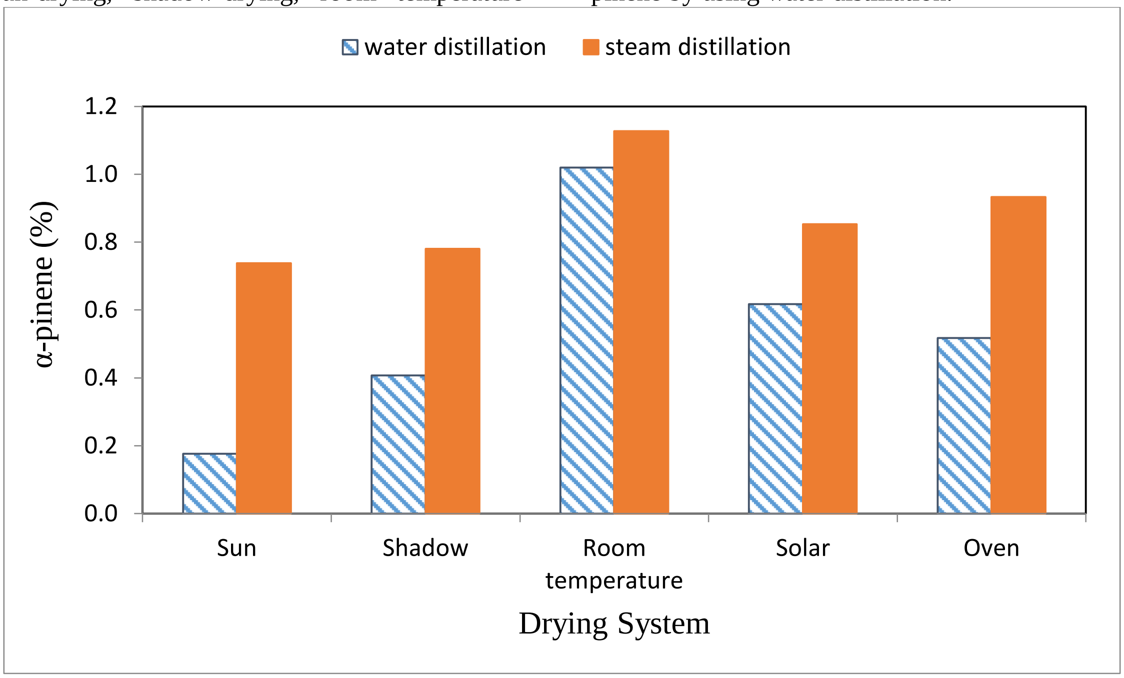


Figure (6): The α-pinene for different distillation methods and different drying systems.

1.6. β-pinene:

Figure (7) shows the β-pinene for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the β-pinene values were 3.943 and 4.647, 4.397 and 5.163, 8.753 and 11.478, 6.234 and 9.045 and 8.096 and 9.397 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 11.52 % for fresh basil. The results indicate that the highest value of the β-pinene for water and steam distillation (8.754 and 11.478 %) was obtained when the basil dried at room temperature system. Meanwhile, the lowest value of the β-pinene for water and steam distillation (3.943 and 4.647 %) was found at the sun-drying system. The results also indicate that the β-pinene by using steam distillation higher than those β-pinene by using water distillation.

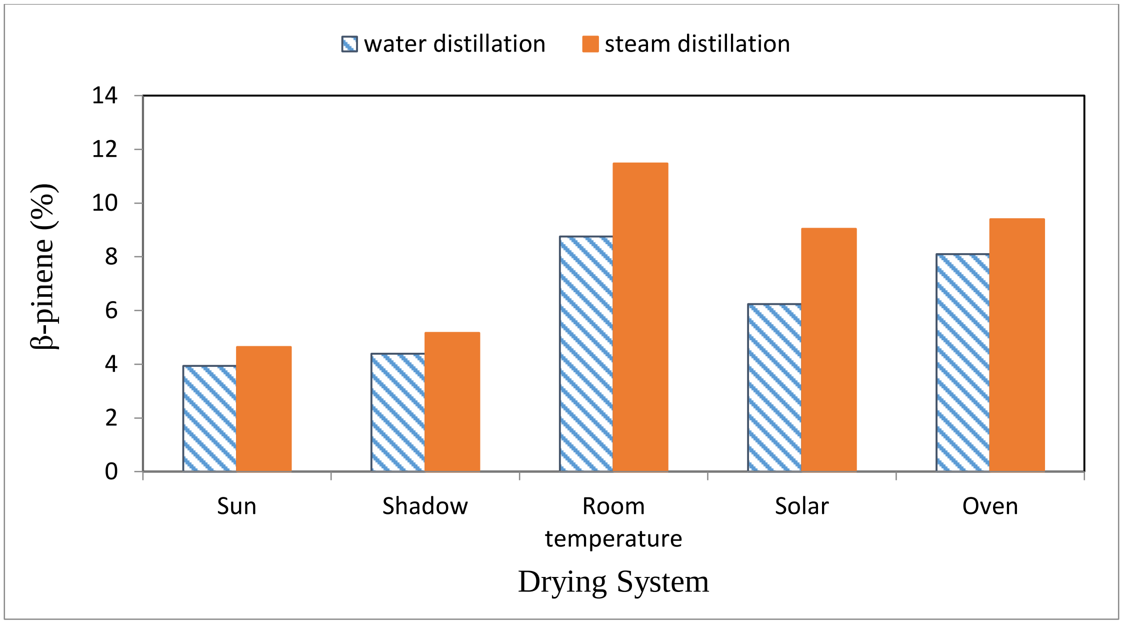


Figure (7): The β-pinene for different distillation methods and different drying systems.

1.7. Linalool:

Figure (8) shows the linalool for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the linalool values were 35.878 and 38.932, 41.542 and 43.938, 45.556 and 46.616, 39.853 and 40.690 and 36.154 and 39.191 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 47.21 % for fresh basil. The results indicate that the highest value of the linalool for water and steam distillation (45.556 and 46.616 %) was obtained when the basil dried at room temperature system. Meanwhile, the lowest value of the linalool for water and steam distillation (35.878 and 38.932 %) was found at the sun-drying system. The results also indicate that the linalool by using steam distillation higher than those linalool by using water distillation.

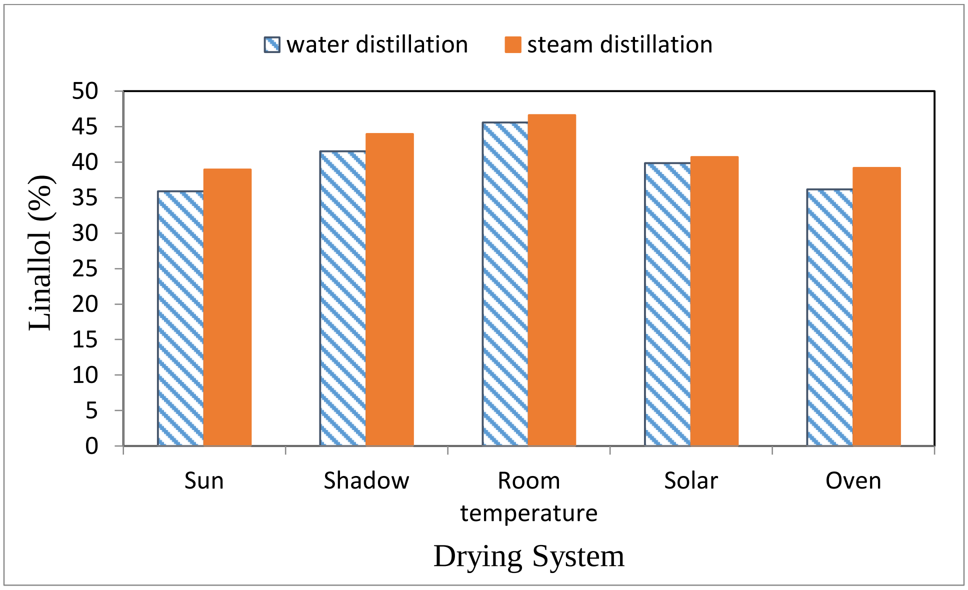


Figure (8): The linalool for different distillation methods and different drying systems.

1.8. Camphor:

Figure (9) shows the camphor for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the camphor values were 4.741 and 7.460, 3.284 and 5.547, 8.019 and 10.910, 4.776 and 6.284 and 3.037 and 4.099 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 11.23 % for fresh basil. The results indicate that the highest value of the camphor for water and steam distillation (8.019 and 10.910 %) was obtained when the basil dried at room temperature system. Meanwhile, the lowest value of the camphor for water and steam distillation (3.0366 and 4.099 %) was found at the oven-drying system. The results also indicate that the camphor by using steam distillation higher than those camphor by using water distillation.

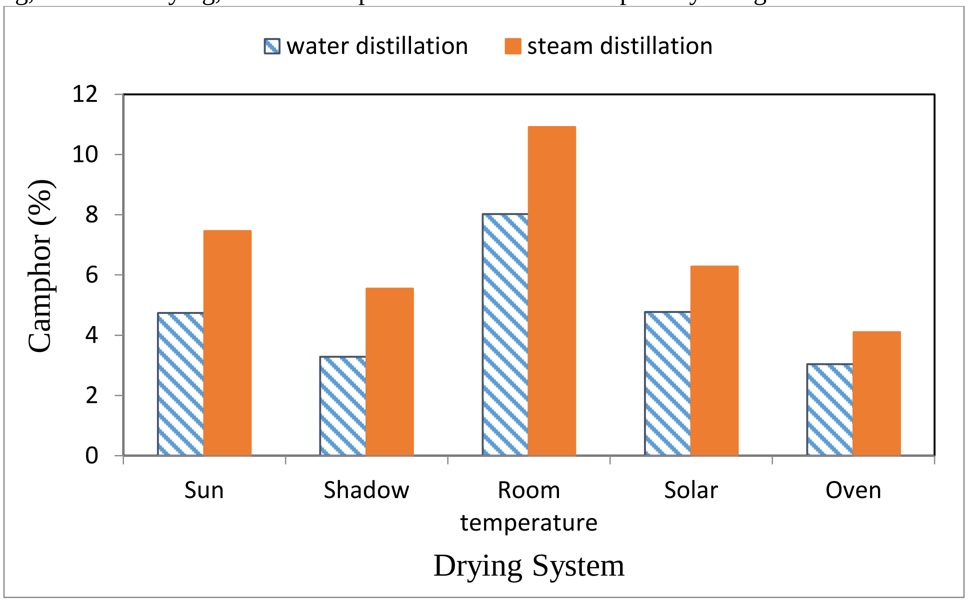


Figure (9): The camphor for different distillation methods and different drying systems.

1.9. Methyl Chavicol:

Figure (10) shows the methyl chavicol for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the methyl chavicol values were 7.078 and 5.823, 5.636 and 4.550, 6.317 and 4.839, 11.539 and 7.208 and 8.363 and 6.798 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 11.85 % for fresh basil. The results indicate that the highest value of the methyl chavicol for water and steam distillation (11.539 and 7.208 %) was obtained when the basil dried at solar-drying system. Meanwhile, the lowest value of the methyl chavicol for water and steam distillation (5.636 and 4.550 %) was found at the shadow-drying system. The results also indicate that the methyl chavicol by using water distillation higher than those methyl chavicol by using steam distillation.

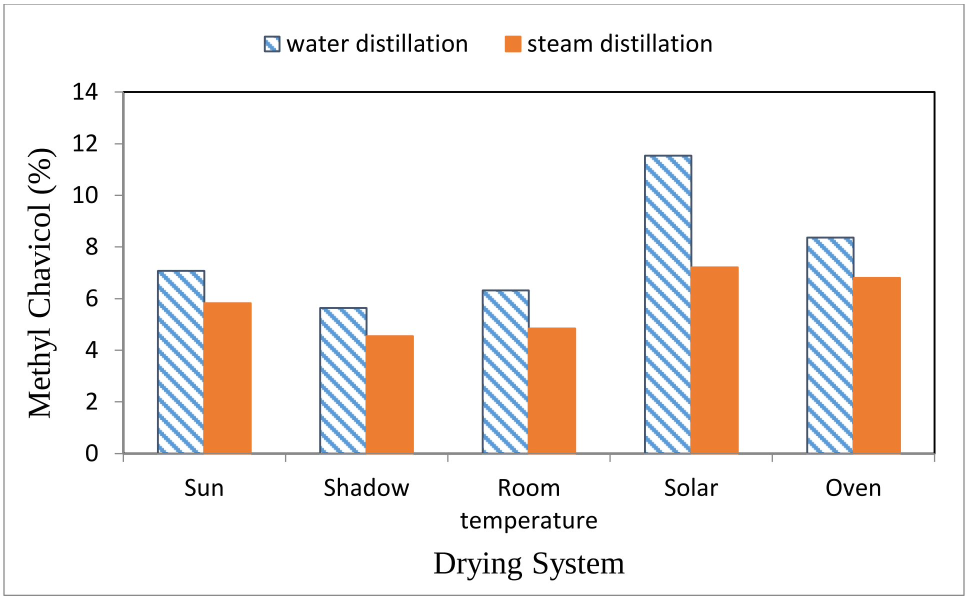


Figure (10): The methyl chavicol for different distillation methods and different drying systems.

1.10. Geraniol:

Figure (11) shows the geraniol for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the geraniol values were 8.676 and 7.743, 4.058 and 3.372, 3.962 and 3.210, 7.884 and 5.361 and 5.138 and 3.728 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 8.01 % for fresh basil. The results indicate that the highest value of the geraniol for water and steam distillation (8.676 and 7.743 %) was obtained when the basil dried at sun-drying system. Meanwhile, the lowest value of the geraniol for water and steam distillation (3.962 and 3.210 %) was found at the room temperature-drying system. The results also indicate that the geraniol by using water distillation higher than those geraniol by using steam distillation.

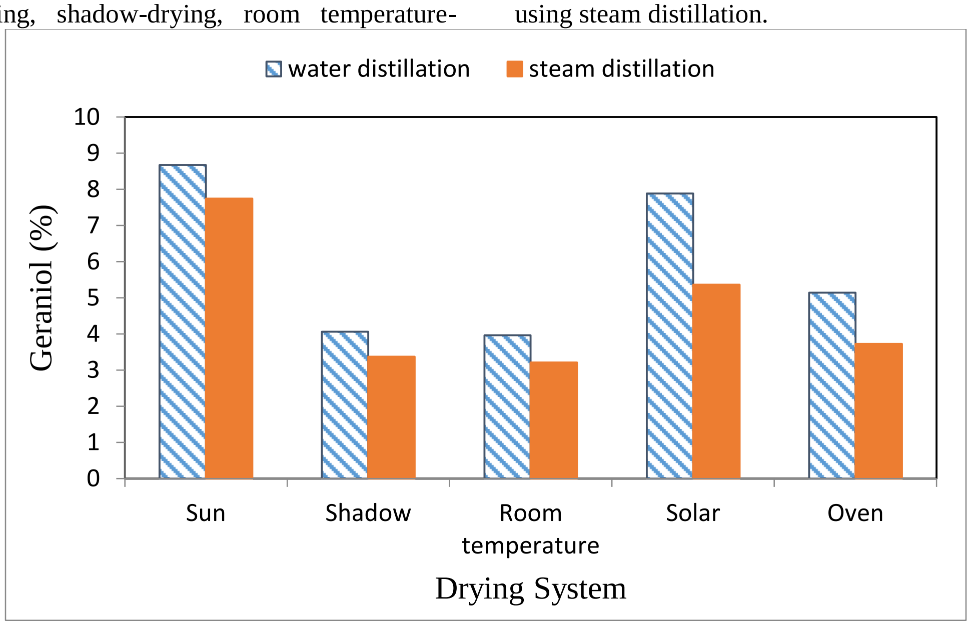


Figure (11): The geraniol for different distillation methods and different drying systems.

1.11. Eugenol:

Figure (12) shows the eugenol for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the eugenol values were 20.954 and 19.422, 25.739 and 23.190, 20.501 and 19.407, 19.141 and 17.731 and 18.404 and 17.408 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 26.32 % for fresh basil. The results indicate that the highest value of the eugenol for water and steam distillation (25.739 and 23.190 %) was obtained when the basil dried at shadow-drying system. Meanwhile, the lowest value of the eugenol for water and steam distillation (18.404 and 17.408 %) was found at the oven-drying system. The results also indicate that the eugenol by using water distillation higher than those eugenol by using steam distillation.

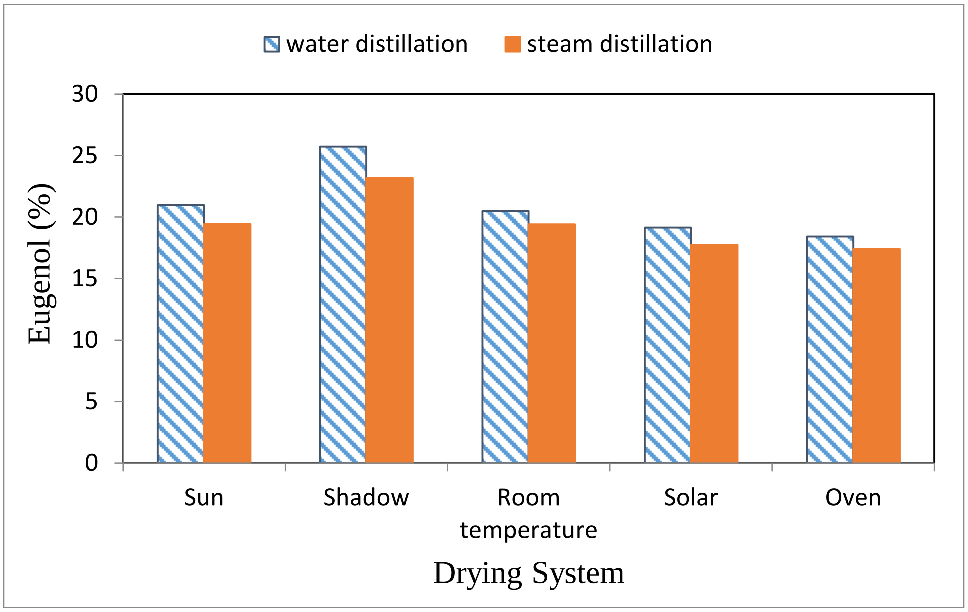


Figure (12): The eugenol for different distillation methods and different drying systems.

1.12. β-caryophelliene:

Figure (13) shows the β-caryophelliene for different distillation methods (water and steam distillation) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying) at the end of experiment. It could be seen that the β-caryophelliene values were 2.525 and 2.391, 0.595 and 0.487, 1.263 and 0.534, 2.988 and 2.525 and 2.318 and 1.117 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, compared to 2.97 % for fresh basil. The results indicate that the highest value of the β-caryophelliene for water and steam distillation (2.988 and 2.525 %) was obtained when the basil dried at solar-drying system. Meanwhile, the lowest value of the β-caryophelliene for water and steam distillation (0.595 and 0.487 %) was found at the shadow-drying system. The results also indicate that the β-caryophelliene by using water distillation higher than those β-caryophelliene by using steam distillation.

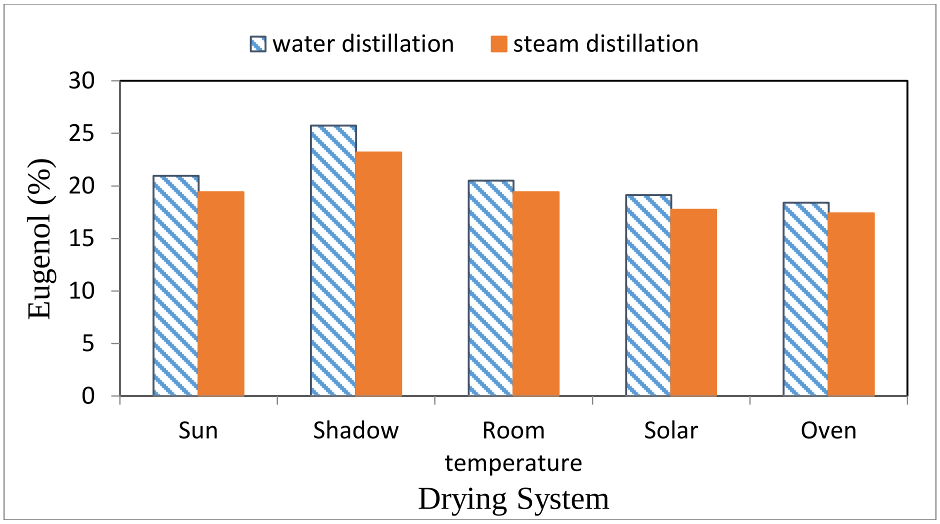


Figure (13): The β-caryophelliene for different distillation methods and different drying systems.

3.11. Costs:

Table (2) shows the total costs of basil essential oil production at different distillation methods (water and steam) and different drying systems (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying). The total costs of basil essential oil production were 1.52, 1.40, 1.21, 1.29 and 1.75 L.E g^{-1} of basil essential oil production for sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, for water distillation method. For steam distillation methods, the total costs of basil essential oil production were 1.46, 1.03, 0.87, 1.29 and 1.52 L.E g^{-1} of basil essential oil production for sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively.

Table 2. The total costs of basil essential oil production.

Drying System	Cost, LE g^{-1} oil	
	water distillation	steam distillation
Sun	1.52	1.46
Shadow	1.40	1.03
Room temperature	1.21	0.87
Solar	1.29	1.29
Oven	1.75	1.52

Conclusion

The experiment was carried out to study was conducted to investigate the effect of different distillation methods (water and steam) on essential oil yield and composition of sweet basil as affected by drying methods (sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying). The obtained results can be summarized as follows:

- The basil essential oil content values were 2.3 and 2.4 % for water and steam distillation, respectively, for the sun-drying after 180 min, and they were 2.5 and 3.4, 2.9 and 4.0, 2.7 and 2.7 and 2.0 and 2.3 % for water and steam distillation, respectively for the shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively, after 165 min.
- The α-pinene and β-pinene by using steam distillation higher than those α-pinene and β-pinene by using water distillation.
- The highest values of the linalool for water and steam distillation were 45.556 and 46.616 % was obtained when the basil dried at room temperature system.
- The camphor and methyl chavicol values ranged from 3.037 to 10.910 and 4.550 to 11.539 %, respectively, for all treatment.
- The geraniol values were 8.676 and 7.743, 4.058 and 3.372, 3.962 and 3.210, 7.884 and 5.361 and 5.138 and 3.728 % for water and steam distillation, respectively for the sun-drying, shadow-drying, room temperature-drying, solar-drying and oven-drying, respectively.

- The eugenol and β-caryophelliene values ranged from 17.408 to 25.739 and 0.487 to 2.525 %, respectively, for all treatment.
- The total costs of basil essential oil production ranged from 0.87 to 1.75 LE g^{-1} of essential oil.

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تأثير طرق الاستخلاص على انتاجية الزيت ومكوناته للريحان المجفف بنظم تجفيف مختلفة

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ويهدف هذا البحث الى دراسة تأثير طرق استخلاص مختلفة على محتوى الريحان من الزيت ومكوناته المختلفة باستخدام طرق تجفيف مختلفة لتحديد افضل طريق تجفيف للمحافظة على المكونات الرئيسية لزيت الريحان. وتم إجراء هذه التجربة فى قسم هندسة النظم الزراعية والحيوية – كلية الزراعة بمشتهر – جامعة بنها – محافظة القليوبية. وكانت اهم النتائج المتحصل عليها كما يلى: كان محتوى الريحان من الزيت 2.3 و2.5 و3.4 و2.7 و2.0 % لكل من نظام التجفيف الشمسى الطبيعى والتجفيف فى الظل والتجفيف فى الغرفة والتجفيف الشمسى الغير مباشر والتجفيف فى الفرن على الترتيب باستخدام طريقة التقطير المائى وكان محتوى الريحان من الزيت 2.4 و2.9 و4.0 و2.7 و2.3 % لكل من نظام التجفيف الشمسى الطبيعى والتجفيف فى الظل والتجفيف فى الغرفة والتجفيف الشمسى الغير مباشر والتجفيف فى الفرن على الترتيب باستخدام طريقة التقطير بالبخار. كان الالفا بينين والبيتا بينين الناتجة من طريقة التقطير بالبخار على من القيمة الناتجة من طريقة التقطبر بالماء. كانت اعلى قيمة للنالنولين الناتج من طريقة التقطير بالماء والبخار هى 45.556 و46.616 % وكانت مع طريقة التجفيف فى الغرقة. تراوحت قيمة الكامفور والمثيل كوفيكول من 3.037 الى 10.910 ومن 4.550 الى 11.539 % لكل من طريقة التقطير بالماء والبخار على الترتيب لكل نظم التجغبف المختلفة. كانت اعلى قيمة للجيرانول الناتج من طريقة التقطير بالماء والبخار هى 8.676 و7.743 % وكانت مع طريقة التجفيف الشمسى الطبيعى. تراوحت قيمة الإجينول والبيتا كاريفيلين من 17.408 الى 25.739 ومن 0.487 الى 2.525 % لكل من طريقة التقطير بالماء والبخار على الترتيب لكل نظم التجغبف المختلفة. تراوحت تكاليف انتاج زيت الريحان ما بين 0.87 الى 1.75 جنيه لكل جرام زيت ريحان.