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Research

Production and Chemical Constituents of Basil Oil (Ocimum Basilicum L) Extracted from Steam Distillation and Hydrodistillation Extraction Process

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Abstract:
Steam distillation and hydrodistillation are the two methods used to extract essential oil from (Ocimum basilicum L) Oil. This study demonstrated that both the steam distillation and hydrodistillation processes are appropriate for extracting the essential oil of (Ocimum basilicum L) Oil because of their ability to yield higher yields of 1.20±0.02% and 1.60±0.02%, respectively, and because of their faster extraction periods. After analysis with GC-MS (gas chromatography mass spectrometry) and GLC (gas liquid chromatography), the total number of major and minor chemical molecules were found to be approximately similar. That is, the total number of chemical molecules in the (Ocimum basilicum L) Oil obtained by using steam and hydro distillation extraction methods, respectively, were 29 and 32.
Keywords: (Ocimum basilicum L) Oil, Distillation, Yield, Chemical Composition

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I. INTRODUCTION

Essential oils (EOs) are products resulting from the secondary metabolism of plants, composed of complex mixtures of low molecular weight compounds and obtained from different methods of extraction (Chouhan et al., 2019). Currently, several applications of EOs have been described in the literature, including in the food and beverage industry, flavour and fragrance industry, agriculture feld, alternative medicine, natural therapies, and, mainly, pharmaceutical industry. Especially in the food area, the application of EOs could be highly valuable due to the growing concerns on adverse health effects of synthetic preservatives and the consequent demand for natural preservatives. Essential oils could be applied to extend the shelf life of foods, owing to its antimicrobial and antioxidant properties, besides its use as a favoring agent. Among essential oils with food applications already described in the scientific literature is the oil from basil (Ocimum basilicum L.), an herb belonging to the Lamiaceae family, considered the most cultivated aromatic herb variety worldwide. They are mainly found in the tropical regions of Asia, Africa, and Central and South America. The basil leaves are widely used in culinary, in fresh or dry form, as food favoring, and as an ornamental plant in house garden (Filip et al., 2016). There are several varieties of O. basilicum species, which differ mainly in their morphological structure. This consequently influences the content of essential oil, as well as its chemical composition. Overall, the major components of the basil essential oil (BEO) are the terpenes and phenylpropanoids, followed by alcohols and aldehydes (Milenković et al., 2019). The market value of Ocimum species is predominately based on their essential oil content and ornamental characters (Mahmoudi et al., 2020). Several studies have reported biological activities of the essential oil from O. basilicum. These include antimicrobial, antifungal, insect repelling, antioxidant, anticancer, and anti-inflammatory activities. These biological activities are mainly attributed to their essential oils rich in linalool and phenolic compounds (Mahmoudi et al., 2020).

Basil essential oil content, as well as its yield and composition, is infuenced by several factors, such as cultivars, chemotypes, growing conditions, and method of extraction and drying (Milenković et al., 2019). Several methods for the extraction of basil essential oil have been proposed in the literature. Table 1 shows the advantages and disadvantages of the main methods proposed for extraction of BEO, as well as for extraction of essential oils from other sources. Among these methods, steam distillation (SD) and hydrodistillation (HD) are the two most used methods for the extraction of essential oil from basil, due to their economic feasibility and simplicity (Shiwakoti et al., 2017). Steam distillation involves the heating of the plant material by passing water steam, which promotes the opening of glands and essential oil evaporation, causing it to rise with the steam. Then, the essential oil is collected by condensation. On the other hand, hydrodistillation is based on immersion and boiling of material in water. In this method, essential oil is also collected in a condenser (Sefdkon et al., 2007). Shiwakoti et al. (2017) evaluated the efciency of the two BEO extraction methods (HD — hydrodistillation vs SD — steam distillation) and concluded that steam distilla- tion showed better performance. The SD method presented a higher yield of essential oil (0.32–0.68 g of essential oil/100 g of dried leaves) than HD (0.08–0.32 g of essential oil/100 g of dried leaves) for both basil species tested. Milenković et al. (2019) studied the effect of growing conditions and different times of harvest in the yield of basil essential oil. The basil was grown in the soil under two conditions: covered by color nets (50% shade index) or in unshaded condition (open feld control). The basil essential oil was obtained by Clevenger-type hydrodistillation with a ratio of 1:10 w/v (plant material: water) during 120 min. The second harvest from unshaded, control plants, showed the lowest accumulation of essential oils (1.02 mL/100 g), while the first harvest from shaded plants presented the highest oil accumulation (3.23 mL/100 g). The synthesis of essential oils is influenced by light quantity and quality. Shading affects solar radiation, regulating plant growth, development and biosynthesis of metabolites, such as essential oils (Carvalho et al., 2016; Ilić et al., 2017).
The present investigation aims to examine the chemical composition of Basil oil obtained by innovative techniques including steam distillation and hydrodistillation (HD). The goal of the current research is to ascertain whether producing more or better Basil oil may be achieved through the use of green methods.

II. OIL EXTRACTION PROCESS FROM OCIMUM BASILICUM L.

A. Clevenger-Hydrodistillation Method

The hydrodistillation process was used to extract (Ocimum basilicum L) Oil essential oil using the Clevenger distillation method (fig 1(a). To begin, 3000 mL of water was added to 300 g of small pieces of (Ocimum basilicum L) Oil leaves. The weighed pieces of (Ocimum basilicum L) Oil leaves were placed into a 5000 ml Clevenger distillation flask. The essential oil volume (mL) was continuously collected after 8 hours of distillation. Finally, the essential oil was dehydrated (de-moisturized) using sodium sulfate. The distillation yield of the essential oil obtained was calculated using the following equation: (1).

$$\text{Yield\% of (Ocimum basilicum L) Oil} = \frac{\text{Weight of (Ocimum basilicum L) Oil}}{\text{Weight of (Ocimum basilicum L) Oil}} \times 100 \qquad (1)$$

B. Steam Distillation

Steam distillation process carried out as water is boiled to create steam, which then travels through a (Ocimum basilicum L) leaves (fig 1 (b). The steam breaks the structure of leaves, extracts oil, and then flows into the condenser. There, it becomes a liquid solution of water and oil and goes into a separator. The oil being lighter than water is physically separated and the water is discarded. The oils are clear.

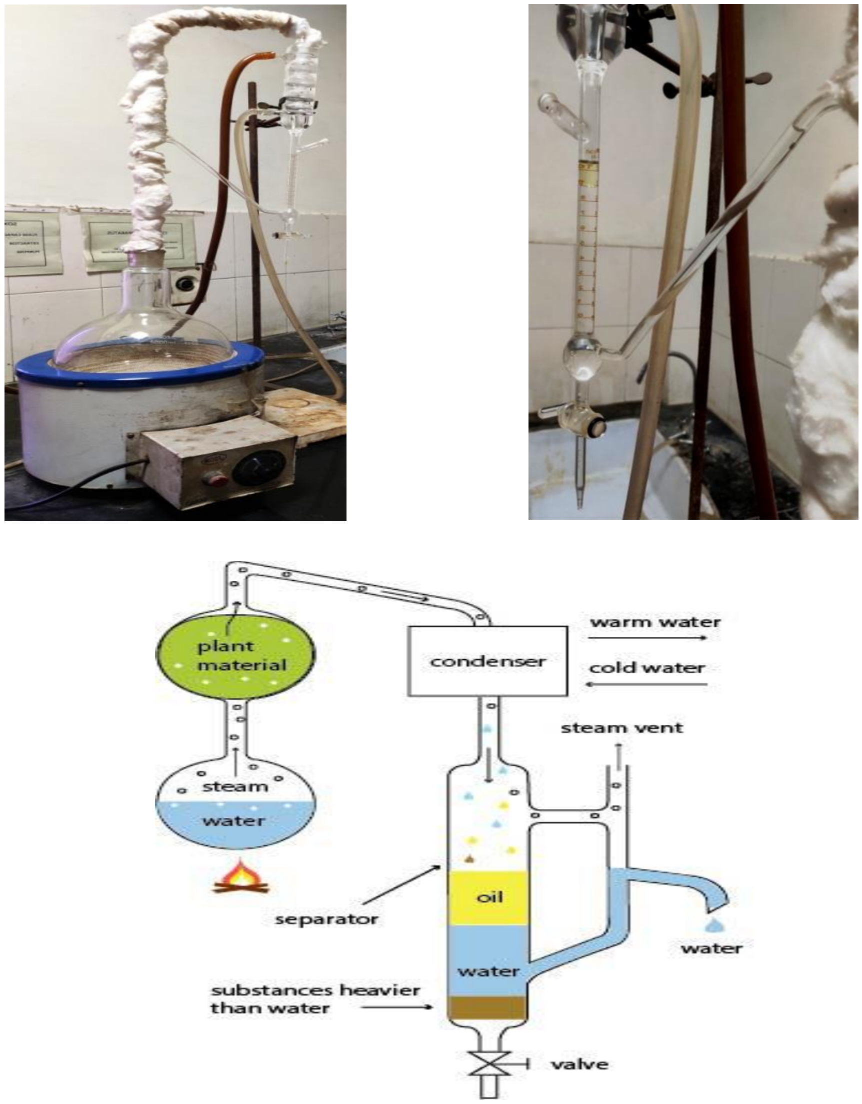

Figure-1. (a) Hydrodistillation-Clevenger method (b) Steam distillation method

C. Yield of Essential Oil

The yield percentage was calculated as a volume of essential oil per 100 g of (Ocimum basilicum L) leaves weight. Essential oils acquired from (Ocimum basilicum L) leaves by Hydro distillation and Steam distillation methods produced an oil with colour clear, pale yellow. It exudes a strong aroma that smells floral and citrusy scent liquid with strong scent. The yield in both used distillation methods is different as shown in table 1. It indicates that the amount of essential oil yield is influenced by used distillation method.

Table 1: Essential oil yield of (Ocimum basilicum L) oil under different oil extraction distillation methods

S.N.	**Essential oil recovery under different isolation methods**	**Yield (%)**
1.	Steam distillation (SD)	1.20±0.02
2.	Hydro distillation (HD) using Clevenger apparatus	1.60±0.02

III. RESULT AND DISCUSSION

A. Physio-chemical properties

It has been observed that physical and chemical values are almost similar. There are identified total 29 and 31 major and minor percentage of chemical molecules in the (Ocimum basilicum L) Oil obtained from the hydrodistillation and steam distillation, respectively by the GC-MS analysis.

Table 2. Physicochemical properties of (Ocimum basilicum L) oil at 27 °C extracted by different hydrodistillation & steam distillation methods.

Parameter	**Steam distillation (SD)**	**Hydro distillation (HD)**
Colour/odour	Clear, pale yellow floral and citrusy scent	Clear, pale yellow floral and citrusy scent
Optical rotation	-06.00°	-06.50°
Specific Gravity	0.9358	0.9368
Refractive Index	1.5023	1.5043
Solubility	Soluble (ethanol 80% vol.) 1.90 volume	Soluble (ethanol 80% vol.) 1.90 volume
Acid Value	00.92%	00.86%

B. Chemical Composition of (Ocimum basilicum L) essential Oil

The qualitative and semi-quantitative composition of the essential oils is reported in Table 3, where the components are listed according to the class of compounds. Content (expressed as %) was calculated as ratio of peak area of individual compound and total peaks area in GC-MS chromatograms. The composition of (Ocimum basilicum L) Oils obtained by both distillation techniques is approximately similar identified total compounds and also in their relative percentage amount. Gas Chromatogram-Mass Spectrosmetry (GC-MS) analysis revealed the major components are separated in the (Ocimum basilicum L) Oil obtained from steam distillation method (table 3), whereas three major molecules were found significant variations in the percentage quantity in the (Ocimum basilicum L) Oil obtained from hydodistillation and steam distilled method as well.

Table 3: Major chemical molecules separated by Gas Chromatography of (Ocimum basilicum L) oil essential oils from different oil-extraction distillation methods.

Compound (%)	**Steam distillation (SD)**	**Hydro distillation (HD)**
1,8-cineole+lemonene	8.87%	7.37%
Linalool	48.1%	48.2
Methyl Chavicol	28.3%	31.6%

IV. CONCLUSION

This research demonstrate that both technology i.e. hydro and steam distillations are almost similar for the extraction of (Ocimum basilicum L) Oil essential oil quantity and total number chemical constituents are producing similar. GC-MS analysis revealed that 31 of the total major and minor components in (Ocimum basilicum L) Oil were found in steam distilled (Ocimum basilicum L) Oil, whereas 29 number of chemical molecules were analyzed in the extracted (Ocimum basilicum L) Oil from hydodistillation method. In conclusion, it is not possible to say with certainty whether hydrodistillation or steam distillation is better because each of them has similar results in yield and chemical composition of (Ocimum basilicum L) Oil essential oils.

REFERENCES

1. Chouhan, K. B. S., Tandey, R., Sen, K. K., Mehta, R., & Mandal, V. (2019). Critical analysis of microwave hydrodifusion and gravity as a green tool for extraction of essential oils: Time to replace traditional distillation. Trends in Food Science & Technology, 92, 12–21. https://doi.org/10.1016/j.tifs.2019.08.006
2. Filip, S., Vidović, S., Vladić, J., Pavlić, B., Adamović, D., & Zeković, Z. (2016). Chemical composition and antioxidant properties of Ocimum basilicum L. extracts obtained by supercritical carbon dioxide extraction: Drug exhausting method. J. of Supercritical Fluids, 109, 20–25. https://doi.org/10.1016/j.supfu.2015.11.006
3. Milenković, L., Stanojević, J., Cvetković, D., Stanojević, L., Lalević, D., Šunić, L., Fallik, E., & Ilić, Z. S. (2019). New technology in basil production with high essential oil yield and quality. Industrial Crops and Products, 140, 111718. https://doi.org/ 10.1016/j.indcrop.2019.111718
4. Mahmoudi, H., Marzouki, M., M'Rabet, Y., Mezni, M., Ouazzou, A.A., Hosni, K. (2020). Enzyme pretreatment improves the recovery of bioactive phytochemicals from sweet basil (Ocimum basilicum L.) leaves and their

hydrodistilled residue by-products, and potentiates their biological activities. Arabian Journal of Chemistry. https://doi.org/10.1016/j.arabjc.2020.06.003

5. Shiwakoti, S., Saleh, O., Poudyal, S., Barka, A., Qian, Y., & Zheljazkov, V. D. (2017). Yield, composition and antioxidant capacity of the essential oil of sweet basil and holy basil as infuenced by distil- lation methods. Chememical Biodiversity, 14,
6. Sefdkon, F., Abbasi, K., Jamzad, Z., & Ahmadi, S. (2007). The efect of distillation methods and stage of plant growth on the essential oil content and composition of Satureja rechingeri Jamzad. Food Chemistry, 100, 1054–1058. https://doi.org/10.1016/j.foodchem. 2005.11.016
7. Carvalho, S. D., Schwieterman, M. L., Abrahan, C. E., Colquhoun, T. A., & Folta, K. M. (2016). Light quality dependent changes in morphology, antioxidant capacity, and volatile production in sweet basil (Ocimum basilicum). Frontiers in Plant Science, 7, 1–14. https://doi.org/10.3389/fpls.2016.01328.
8. Ilić, S. Z., Milenković, L., Dimitrijević, A., Stanojević, L., Cvetković, D., Kevrešan, Ž, Fallik, E., & Mastilović, J. (2017). Light qual- ity manipulation by color nets improve quality of lettuce from summer production. Scientia Horticulturae, 226, 389–397. https://doi.org/10.1016/jienta.2017.09.009

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