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Original Article

Comparative Study on Essential Oils of *Lavandula officinalis* L. from Three Different Sites with Different Methods of Distillation

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Abstract

Lavandula angustifolia Mill. syn. *Lavandula officinalis* Chaix was commonly known as lavender is a species of the genus *Lavandula* from *Lamiaceae* family is among the top 10 pharmaceutical plant. Lavender species are grown worldwide primarily for their essential oils, which are used in the food processing, aromatherapy products, cosmetics and perfumes. The purpose of this study was to investigate the essential oils composition of lavender (*Lavandula officinalis* L.) cultivated in 3 provinces, Esfehan, Tehran, and Alburz province in Iran. This research examines it has been done on effects of different methods of distillation and habitat conditions on quantity and quality of oil of *Lavandula officinalis* flowering top plants cultivated in three regions were collected and after drying at room temperature in shadow. Esstential oils were extracted with three methods of distillation (water, steam and water and steam). Thirty compounds were identified in the essential oils, respectively. Components of essential oils from the *Lavandula officinalis* L. were determined using gas chromatography (GC) and Gas Chromatography- Mass Spectrometry (GC-MS). The important components in the Kashan area from Isfahan province were1,3,8-p- menthatriene (37.7 upto 39.8%), γ- terpinene (17.1 upto 19%), Linalyl formate (13.1 upto 15.08%), oil yield were 8.54 upto 10.03%, respectively. The important components in the Alburz province were ,3,8-p-menthatriene (31.7 upto 34.2%), γ- terpinene (24.2 upto 26.4%), Linalyl formate (11.8 upto 14%), oil yield were 5.5 upto 6.12%, respectively. The important components in the Tehran province were 1,3,8-p- menthatriene (32.5 upto 34.1%), γ- terpinene (25 upto 29.8%), Linalyl formate (7.8 upto 9%), oil yield were 10.26 upto 12.13%, respectively.

Keywords: *Lavandula officinalis*, Essential oil, Cultivated, Distillation, Gas chromatography

Introduction

Lamiaceae family has cosmopolitan distribution. *Lavandula angustifolia* Mill. syn. *Lavandula officinalis* Chaix was commonly known as lavender is a species of the genus *Lavandula* from *Lamiaceae* family [1] , native to southern Europe and the Mediterranean area, grows in full sun on dry, well-drained, stony calcareous soils [2].

Lavender species are grown worldwide primarily for their essential oils, which are used in the food processing, aromatherapy products, cosmetics and perfumes [3,4].

L. *angustifolia* is a perennial herbaceous plant being one of the most loved aromatic and medicinal plants in the world. Lavender is the term, which comes from Latin word "lavando" derived as a part of the verb "lavare" which means “to wash”. The Romans used lavender for obtaining a pleasant smell in their bath, as well as for its beneficial effect on health [1]. The plant grows as a small shrub up to 60 cm high with the blue-violet flowers, which contain essential oil, responsible for

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the plant's beautiful scent. It is native to the Mediterranean areas [1,5]. The dried incompletely developed blossoms of the lavender plant have been used, as an official drug [6].

The main constituents of lavender dried blossoms essential oil are linalool, linalyl acetate, cineole, camphor and β-ocimene. The plant also contains a high percentage of tannins up to 12 %. The essential oil extracted from the fresh blossoms of lavender contains in high percentage linalool and linalyl acetate [6].

According to the European Pharmacopoeia, 8th Edition (Ph. Eur. 8.0), lavender flowers should contain at least 13 ml / kg of anhydrous essential oil [7]. Previous studies on the essential oils of many *Lamiaceae* show that, these plants have a broad range of biological activities, notably their antimicrobial potency [8]**.** Lavender oil was also reportedto be an effective antifungal agent against *Aspergillus nidulans* and *Trichophyton mentagrophytes* [9].

Lavender essential oil can be used externally and internally for various purposes. Externally the essential oil is used in salves, balms, cosmetics, perfumes and topical skin preparations. Taken internally essential oil of lavender is believed to have a beneficial effect on many health impairments, including anxiety, stress, depression, irritability, nervousness, exhaustion, insomnia, headaches, migraines, colds, flatulence, upset stomach, digestion, loss of appetite, liver and gallbladder problems. In addition, it has been known as a breath freshener and mouthwash [10].

Dried lavender flowers have been used for tea-like preparation for improving the mood disorder, insomnia and lassitude, also with beneficial effects on abdominal complaints. Lavender essential oil has its application as a corrector of the taste and odour for pharmaceutical preparations, also as a rubefacient and insecticide [11].

According to the U.S. Food and Drug Administration, *L. officinalis* has been classified as safe and has been included on the safe substances list, commonly known as "Generally Recognised as Safe" (GRAS) [6]. Lavender oils contain more than 100 compounds, with the two major constituents being linalool and linalylacetate [12,13].

The purpose of this study was to investigate the essential oils composition of lavender (*Lavandula officinalis* L.) cultivated in 3 provinces, Esfehan, Tehran, and Alburz province in Iran.

Material and Methods

Plant Material

The plant material used in this study was collected in January 2016 from 3 provinces, Esfehan, Tehran, and Alburz province in Iran.

Extraction of Essential Oils of *Lavandula officinalis* L.

The oils were taken from flower top *Lavandula officinalis* L. (100 g) with different methods of distillation (water distillation, steam distillation and water-steam distillation), for 3h at atmospheric pressure to yield the essential oil were calculated on a fresh weight basis (W/W).

The oils yields in the Kashan area from Isfahan province with water distillation were 10.03%, steam distillation 8.54% and water and steam distillation 9.68%, respectively. Yield the essential oil were in the Alburz province were with water distillation were 5.5%, steam distillation 5.7% and water and steam distillation 6.12%, respectively. Yield the essential oil were in the Tehran province were with water distillation were 10.26%, steam distillation 11.37% and water and steam distillation 12.3%, respectively. The oil extracts were stored in sterile dark vials at 4 °C for future uses.

Gas Chromatography

GC analyses were performed using a gas chromatography, Ultera Fast Module –GC, made in Italia. Profile column machine brand Ph-5 capillary column, manufactured by Shimadzu with Length of 30 mm and an inner diameter of 1.0 mm thick 25.0 mm, The inner surface of the stationary phase material is covered Phenyl Dimethyl Siloxane 5%. Column temperature program: initial temperature 60 °C to start the final temperature of 210 °C. The initial 3 °C per minute to be added and then injected into the chamber to a temperature of 280 °C. The carrier gas inlet pressure to the column: helium with a purity of 99.99% of the inlet pressure to the column equal to 5.1 kg per square centimeter is set.

Gas Chromatography - Mass Spectrometry

The GC/MS unit consisted of a Varian Model 3400 gas chromatograph coupled to a Saturn II ion trap detector was used . The column was same as GC, and the GC conditions were as above. Mass spectrometer conditions were: ionization potential 70 eV; electron multiplier energy 2000 V.

The identity of the oil components was established from their GC retention indices, relative to C7- C25 n-alkanes, by comparison of their MS spectra with those reported in the literature [14-16], and by computer matching with the Wiley 5 mass spectra library, whenever possible, by co-injection with standards available in the laboratories.

Results

Essential oil yields found in our samples were different accordance with literature data. The qualitative and quantitative chemical composition assessment was done using both gas chromatography (GC) and gas chromatography/ mass spectrometry (GC/MS) analysis. Using the GC/MS analysis approximately between 25 to 30 components were identified in the analysed samples, which makes 96.95% to 99.74% of the components present in essential oils (Table 1). According fig.1, the important components in the Kashan area from Isfahan province were1,3,8-p-menthatriene (37.7 upto 39.8%), γ- terpinene (17.1 upto 19%), Linalyl formate (13.1 upto 15.08%), oil yield were 8.54 upto 10.03%, respectively. Also, in Fig. 2, the important components in the Tehran province were 1,3,8-p- menthatriene (32.5 upto 34.1%), γ- terpinene (25 upto 29.8%), Linalyl formate (7.8 upto 9%), oil yield were 10.26 upto 12.13%, respectively. And the important components in the Alburz province were ,3,8-p-menthatriene (31.7 upto 34.2%), γ- terpinene (24.2 upto 26.4%), Linalyl formate (11.8 upto 14%), oil yield were 5.5 upto 6.12%, respectively.

Table 1 Comparison of essential oils compositions of *Lavandula officinalis* L. in different Distillation from Iranian

		Esfehan			Alburz			Tehran		
Compounds name	RI	Kaiser & Long	Clevenger	Steam	Clevenger	Kaiser	Steam	Clevenger	Kaiser	Steam
α- pinene	945	0.9	0.7	0.9	1.1	1.4	1.5	1.5	1.8	1.5
n-heptanol	964	0.7	0.6	0.6	0.4	0.5	0.5	0.6	0.6	0.5
Sabinene	973	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1-octen-3-ol	975	0.3	0.3	0.4	0.6	0.7	0.8	0.8	1.0	0.9
β–pinene	979	0.6	0.5	0.6	0.8	0.9	1.0	1.2	1.4	1.2
α-phellandrene	1005	1.0	0.9	1.0	1.8	2.1	2.3	2.3	2.6	2.2
(Z)- β–ocimene	1042	2.0	1.5	2.2	1.1	0.8	1.9	3.0	3.6	2.9
(E)- β–ocimene	1047	0.3	0.3	0.2	0.3	0.3	-	0.2	0.2	0.2
Pentyl isobutaniate	1052	1.3	1.1	1.3	1.2	1.4	1.2	1.9	2.1	1.9
Isopentyl butanoate	1054	0.4	0.4	0.4	0.4	0.2	0.6	0.6	0.8	0.5
γ- terpinene	1061	19.0	18.6	17.1	26.4	24.3	24.2	29.8	28.2	25.0
Terpinolene	1088	1.3	1.3	0.7	-	-	-	0.2	0.2	-
p-cymenene	1093	0.3	0.2	0.5	0.5	0.5	0.8	0.4	0.6	0.9
n-nonanal	1104	1.2	1.2	0.7	0.2		0.2	0.5	0.4	0.3
1,3,8-p-menthatriene	1110	37.7	39.8	37.8	35.4	34.2	31.7	34.1	32.6	32.5
Cis-pinene hydrate	1142	1.4	-	-	-	-	-	-	-	
Isoborneol	1163	0.7	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.7
Terpin-4-ol	1175	7.6	7.8	6.8	7.4	7.2	6.2	6.4	5.9	6.1
n-dodecane	1205	0.2	0.3	0.3	0.5	0.5	0.4	0.4	0.4	0.4
Linalyl formate	1216	13.1	15.08	13.5	14.0	13.0	11.8	9.0	7.8	9.0
(Z)-ocimenone	1230	0.8	1.2	0.7	2.2	1.8	1.6	1.6	1.3	1.5
Pulehone	1235	0.6	0.7	0.4	0.3	-	0.2	0.5	0.4	0.4
Isobornyl formate	1238	0.5	0.2	-	-	0.2	0.2	-	0.1	-
Geraniol	1254	3.4	2.0	4.9	1.3	2.8	3.0	1.0	1.9	2.6
Geranial	1267	0.4	0.2	0.5	0.4	0.3	0.3		0.1	0.2
Neryl formate	1282	0.9	1.1	1.0	0.4	0.5	0.5	0.5	0.5	0.6
E- β–farnesene	1458	1.4	0.3	2.8	0.5	2.8	3.9	0.6	2.6	4.1
n-dodecanol	1470	0.3	-	0.4	-	-	-	-	0.3	0.5
n-pentadecane	1500	0.2	-	0.4	-	0.3	0.3	-	-	0.4
(E-E)-farnesol	1723	0.4	0.8	1.4	0.7	0.6	1.9	0.4	0.3	1.5
Yeild of oil	-	9.68	10.03	8.54	5.5	6.12	5.7	10.26	12.3	11.37

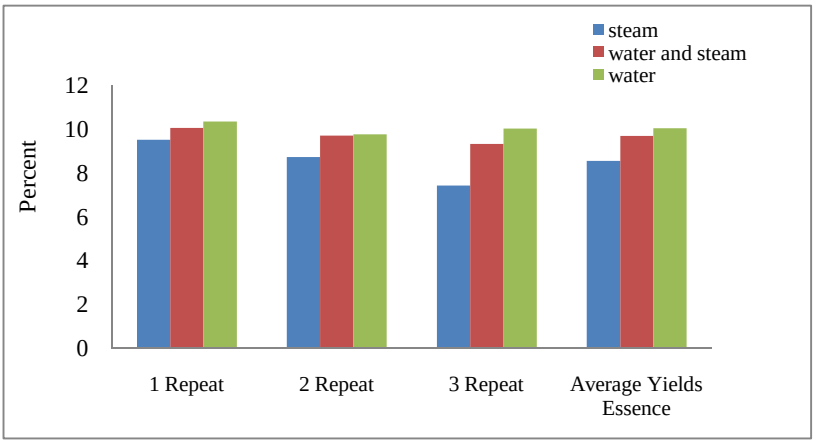

Fig. 1 Comparison chart of Kashan Lavender essential oil

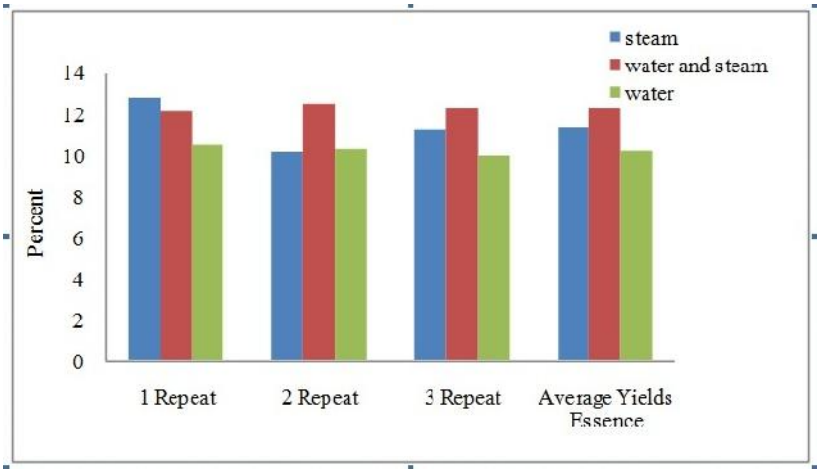

Fig. 2 Comparison chart of Tehran Lavender essential oil

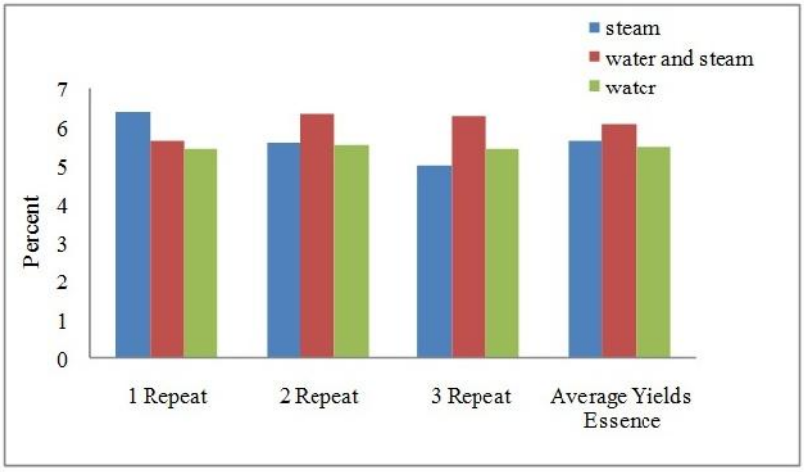

Fig. 3 Comparison chart of Alborz Lavender essential oil

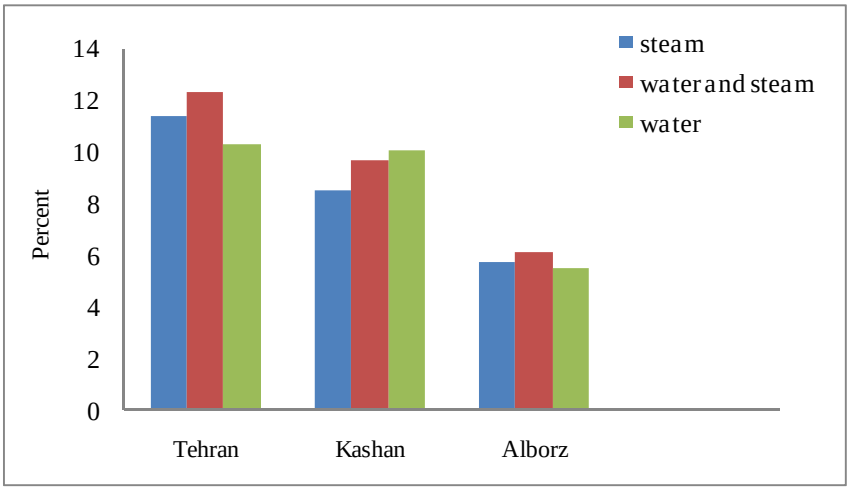

Fig. 4 Comparison chart of average yields three regions-4

Discussion

This study was conducted in 2016 - 2017 at Department of Medicinal plants in Research Institute of Forests and Rangelands in Iran. Results of GC and GC- MS analysis oil extraction of *Lavandula officinalis* L. presented in Table 1. The yield of essential oils (% v/w) amounted to approximately 3 % of dry lavender flowers, according to the Ph. Eur. 8.0 requirements; dried lavender flowers should contain at least 13 ml / kg of anhydrous essential oil [7]. We identified total between 25 to 30 compounds in essential oils in our investigation, the results showed that yield of lavender oils in different province were between 5.5 to 12.3 ml/kg. The application of lavender essential oil for therapeutic purposes depends on its qualitative properties. The main compound of lavender oil in leaves and flowers identified, 1, 3, 8-p-menthatriene which Taran *et al*. (2010) demonstrated the antimicrobial activity of 1, 3, 8-p-menthatriene and some other essential oils of *Ferulago angulata* subsp. *carduchorum* [17]. The essential oil content in the leaves of lavender cultivated in Northwest Iran was found to be 0.64% based on dry weight [18]. Plants have an almost limitless ability to synthesize aromatic substances, most of which are phenols or their oxygen-substituted derivatives [19]. The essential oils of various lavandula species showed that linalool was the most important compounds of these plants. Previous studies and obtained results in this study indicated the existence of differences in the terpenoid chemical composition. These variations with our results and other authors could be due to differences in location, elevation, genetic makeup of the plant or due to an adaptive process to particular ecological conditions. Lawrence also observed a wide variation in the quantitative composition of lavender oil depending on plant genotype and cultivation area, and the composition of the oil from lavenders were recognized to vary significantly according to altitude, microclimate and region [20].

References

1. Balchin ML. “Lavender: The Genus Lavandula”, Taylor and Francis, Inc., London. UK. Hardcover: 296 pages , 2002.
2. Bailey LH. Staff, Liberty Hyde Bailey Hortorium, Hortus Third. Mac Millan Publishing Co. New York, NY. 1976.
3. Jianu C, Pop G, Gruia AT, Horhat FG. Int J Agric Biol. 2013;15:772-776.
4. Meessen LL, Bou M, Sigoillot JC, Faulds CB, Lomascolo A. Essential oils and distilled straws of lavender and lavandin: A review of current use and potential application in white biotechnology. Appl Microbiol Biotechnol. 2015;99:3375-3385.
5. Saadatian M, Aghaei M, Farahpour MR, Balouchi Z. Chemical composition of lavender (*Lavandula officinallis* L.) extraction extracted by two solvent concentrations. Global J Med Plant Res. 2013;1:214-217.
6. Schulz V, Hansel R, Blumenthal M. Tyler VE. A Reference guide for physicians and pharmacists. “Rational Phytotherapy”, by Springer Verlag, Berlin, Heidelberg, New York. 2004;28:173-177 .
7. European Pharmacopoeia, 8th Edition, European Directorate for the Quality of Medicines and Healthcare of the council of Europe, Council of Europe, Strasbourg. 2014.
8. Baratta MT, Dorman HJD, Deans SG, Figueiredo AC, Barroso JG and Ruberto G. Antibacterial and anti-

oxidant properties of some commercial essential oils. Flav Fragr J. 1998;13: 235-244.
9. Moon T, Chan YF, Wilkinson JM, Cavanagh HMA. In Proceeding of AICA National Conference, Adelaide, Australia. 2004;46.
10. Hui L, He L, Huan L, XiaoLan L, AiGuo Z. Chemical composition of lavender essential oil and its antioxidant activity and inhibition against rhinitis related bacteria. African J Microbiol Res. 2010;4:309-313.
11. Kovačević N. "Bases of Pharmacognosy", Serbian school book, Belgrade. 2004.
12. Formacek K. Kubeczka KH. Essential oils analysis by capillary chromatography and Carbon -13 NMR Spectroscopy .J Wiley Sons New York. 1982.
13. Venskutonis PR. Dapkevicius A, Baranauskiene M. Composition of the Essential Oil of Lavender (Lavandula angustifolia Mill.) from Lithuania .J Essent Oil Res. 1997; 107-110 .
14. Adams RP. Identification of essential oils by ion trap mass spectroscopy. Academic Press: New York. 1989 .
15. Shibamoto T. Retention indices in Essential oil analysis. In: Capillary Gas Chromatography in Essential oils analysis. Edits., Sandra, P. and Bicchi, C. Dr. Alferd Huethig Verlag, New York. 1987;259-274.
16. Davies NW. Gas chromatographic retention index of monoterpenes and sesquiterpenes on methyl silicon and carbowax 20M phases, J Chromatogrphy A. 1990;503:1-24.
17. Taran M, Ghasempour HR, Shirinpour, E. Antimicrobial activity of essential oils of *Ferulago angulata* subsp. carduchorum. Jundishapur J Microbiol. 2010;3:10-14.
18. Mohammad BH, Abbas H, Lamia V. Behjat HA, Ali R. Essential oil constituents of *Lavandula officinalis* Chaix. from Northwest Iran. Chemija. 2011;22:167-171.
19. Cowan MM. Plant products as antimicrobial agents. Clinical Microbiological Reviews. 1999;12:564-582 .
20. Lawrence BM. Lavender oil. In: Essential oils 1992-1994; Allured Publishing: Carol Stream, IL. 1995;70-76.