OPEN ACCESS Freely available online

Medicinal & Aromatic Plants

ISSN: 2167-0412

Research Article

Essential oil Composition of Lavender (*Lavandula angustifolia* Mill.) Cultivars Grown in Wondo Genet, Ethiopia

Beriso M. Buta, Abdela B. Kinki*

Department of Food Science and Nutrition, Ethiopian Institute of Agricultural Research, Wondo Genet, Ethiopia

ABSTRACT

Lavender (*Lavandula angustifolia* Mill.) is a perennial crop that belongs to the Lamiaceae family. This study aimed to examine the essential oil compositions of two lavender cultivars grown in Wondo Genet, Ethiopia. The chemical composition of essential oils obtained by hydro-distillation from fresh leave and flowers of lavender samples were analyzed using Gas Chromatography-Mass Spectrometry (GC-MS). The result showed that the major essential oil constituents obtained in flowering lavender were camphor 1,8-cineole, β-Pinene, beta-caryophyllene oxide, Isooctyl alcohol, endo-Borneol, and thujene. The major compound obtained in local lavender essential oils were 1,8-cineole, camphor, β-Pinene, endo-Borneol, alpha. Terpineol, beta-phellandrene, and 1,3-cyclopentadiene. The major compounds found in this study were reported in other research findings done on the same sample. Some compounds found in one cultivar didn't find in the other. For instance, thujene, trans-beta-ocimene, and verbenone were found in only flowering lavender whereas beta-phellandrene, trans-β-terpineol, alpha-bisabolol, and adamantane were found only in local lavender. This shows the slight difference between the two cultivars.

Keywords: Composition; Cultivars; Essential oils; Hydro distillation; GC-MS; Lavender

INTRODUCTION

Lavender (*Lavandula angustifolia* Mill.) is a perennial crop that belongs to the Lamiaceae family [1]. The genus *Lavandula* (Lamiaceae family) is one of the most well-known essential oil crops in the world with 39 species, numerous hybrids, and about 400 officially registered cultivars [2]. The main producing regions are Europe, the Middle East, Asia, Northern Africa, France, and Bulgaria. Those dominate the production but also Morocco, Yugoslavia, Hungary, Italy, Russia, Spain, Romania, Ukraine, and Turkey have production in different amounts [3]. The industrial cultivation and production of lavender as a medicinal and aromatic plant have been rapidly raised during the last years and the world's interest in its essential oil is still increasing. The trade value of essential oil export in the world is approximately 1.90 billion dollars-2.00 billion dollars and about 50 million dollars of this currency belongs to *Lavandula* essential oil [4].

Lavender has been used for centuries as an herbal remedy. Nowadays, these plant essential oils have become commercially popular due to their impression of a "well-being" lifestyle. It yields a highly effective essential oil with very sweet overtones and can be used in balms, salves, and topical applications. Internally, lavender essential oil is believed to be of benefit for a multitude of problems, including stress, anxiety, exhaustion, irritability, headaches, migraines, insomnia, depression, colds, digestion, flatulence, upset stomach, liver and gallbladder problems, nervousness, loss of appetite, and as a breath freshener and mouthwash [5-9].

Essential oils are fragrant volatile oils obtained from plants. They are complex mixtures of several chemical compounds including terpenes, alcohols, aldehydes, and phenols. Lavender oil, obtained from the leaves and flowers of the plant part by hydro-distillation, is chiefly composed of linalyl acetate (3,7-dimethyl-1,6-octadien-3-yl acetate), linalool (3,7-dimethylocta-1,6-dien-3-ol), lavandulol, 1,8-cineole, lavandulyl acetate, and camphor. Whole lavender oil and its major components linalool and linalyl acetate are used in aromatherapy, and in the flavoring and fragrance industries [10].

Correspondence to: Abdela B. Kinki, Department of Food Science, Ethiopian Institute of Agricultural Research, Wondo Genet, P.O. Box 198, Ethiopia, Tel: +251916002205; E-mail: befabdela@gmail.com

Received: 22-Feb-2023, Manuscript No. MAP-23-21901; **Editor assigned:** 24-Feb-2023, PreQC No. MAP-23-21901 (PQ); **Reviewed:** 10-Mar-2023, QC No. MAP-23-21901; **Revised:** 09-May-2023, Manuscript No. MAP-23-21901 (R); **Published:** 16-May-2023, DOI: 10.35248/2167-0412.23.12.447

Citation: Buta BM, Kinki AB (2023) Essential oil Composition of Lavender (*Lavandula angustifolia* Mill.) Cultivars Grown in Wondo Genet, Ethiopia. Med Aromat Pant. 12:447.

The essential oils of the *Lavandula* species have the same chemical composition but these components are present in different proportions. The oil composition and oil yield of *Lavandula* differentiate from each other [11]. Common criteria for the determination of oil quality are camphor, linalool, and linalyl acetate levels of essential oils. According to the ISO 3515:2002 standard, lavender essential oil contains linalool (25%-38%), linalyl acetate (25%-45%), and camphor (0.5%-1.0%). Due to these specifications, the lavender essential oil is used in the food manufacturing industry as a flavoring agent, and a preservative additive for the cosmetics and fragrance industry including soaps, colognes, perfumes, and skin lotions [12-15]. Particularly, lavender essential oil is used in industrial areas such as perfumery, pharmaceuticals, and cosmetics due to its high linalool and linalyl acetate content. Lavender essential oil, with the main active constituents linalool, linalyl acetate, 1,8-cineole, cis and trans-ocimene, terpinene-4-oil and camphor, has been reported to have antimicrobial, anticholinesterase, and antioxidant activities [16-18].

Wondo Genet agricultural research center was the only research center among around 20 agricultural research centers in the Ethiopian institute of agricultural research, which performs research activities on aromatic and medicinal plants. The essential oil composition of lavender essential oil was not done yet in Ethiopia. Therefore, it is important to do a detailed analysis of essential oils to figure out their quality and quantity for the selection of industrial usage. This study aimed to examine the chemical composition of the lavender cultivar's essential oils which were grown in Wondo Genet, Ethiopia.

MATERIALS AND METHODS

Sample collection and preparation

The experiment was carried out in the Wondo Genet agricultural research center. The samples of two lavender cultivars namely flowering lavender and local lavender were collected from the Wondo Genet agricultural research center experimental field at optimum harvesting age. The sampling site was located at an altitude of 1800 m.a.s.l., latitude and longitude of N 39° 1' 44" E 8° 25' 59". The collected samples were weighed and taken to Wondo Genet food science and nutrition research laboratory for essential oil extraction and chemical composition analysis.

Essential oil extraction

The essential oil was extracted from fresh leaves and flowers of lavender cultivars by hydro-distillation method for 3 hours and dried with anhydrous Na_2SO_4 [19].

Chemical composition of essential oil

The chemical composition of the extracted essential oil was analyzed according to K, with some modifications. Essential oil samples in hexane (1:100) were analyzed on an Agilent 7820A gas chromatography system equipped with an Agilent 5975C mass spectrometer detector. The HP-5 MS capillary column (30 m × 0.25 mm, film thickness 0.25 µm) was used. GC and MS conditions were as follows: Oven temperature at 60°C (0 min), 3°C/min to 240°C (1 min), and at the end increased to 280°Cat a rate of 10°C/min (1 min); helium, as the carrier gas, at a flow rate of 1 ml/min; injector temperature 220°C. 1 µl of each sample was injected at a split ratio of 1:10. The mass spectrometry conditions were: Ionization voltage 70 eV, ion source temperature 230°C, transfer line temperature 280°C, and mass range from 50 Da to 550 Da. The MS was operated in scan mode.

Data analysis

Data were analyzed from GCMSD data analysis of the spectrum by using the NIST library.

RESULTS AND DISCUSSION

The chemical composition of two lavender cultivars was analyzed using GC/MS. Essential oil compositions were displayed in Tables 1 and 2. Total ion chromatograms of essential oil of two lavender cultivars were displayed in Figures 1 and 2. GC/MS analysis of essential oils of flowering lavender shown in Table 1 showed that the major constituents of flowering lavender essential oils were camphor with a large peak area followed by 1, 8-cineole, β-pinene, beta-caryophyllene oxide, isooctylalcohol, endo-borneol, (+)-epi-bicyclosesquiphellandrene, alpha-terpineol, thujene respectively and some other compounds. This result showed that the flowering lavender essential oils in this study contain the major constituents (compounds) found in lavender essential oils reported (Figure 1) [20-24].

Table 1: Chemical composition of flowering lavender.

No.	Compound name	RT	PA
1	Thujene	3.55	1.23
2	β-pinene	3.61	5.48
3	Beta-thujene	3.87	0.64
4	1,8-Cineole	4.76	36.14

5	Trans-beta-ocimene	4.89	0.67
6	Terpinolene	6.15	1.01
7	Linalool	6.53	0.91
8	Camphor	7.9	40.25
9	Endo-borneol	8.5	1.93
10	Terpinen-4-ol	8.91	0.83
11	Alpha-terpineol	9.39	1.32
12	Benzenemethanol, .alpha.-2-cyclohexen-1-yl-	9.54	1.3
13	Verbenone	9.98	0.69
14	Caryophyllene	17.88	1.09
15	beta-caryophyllene oxide	24.04	2.74
16	(+)-epi-bicyclosesquiphellandrene	26.29	1.38
17	Isooctyl alcohol	27.93	2.37

Note: RT: Retention Time; PA: Peak Area

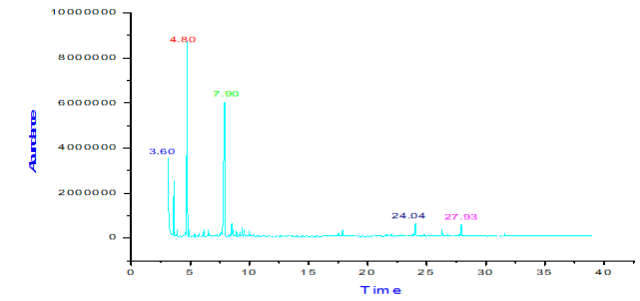

Figure 1: TIC chromatogram of flowering lavender.

GC/MS analysis of essential oils of local lavender shown in Table 2 showed that the major constituents of local lavender essential oils were 1,8-cineole with a large peak area followed by camphor, β-pinene, endo-borneol, alpha-terpineol, beta-phellandrene, 1,3-cyclopentadiene,1,2,3,4,5-pentamethyl-,trans-2,7-dimethyl-4,6-octadien-2-ol,alpha-bisabolol respectively, and many other compounds. This result showed that the local lavender essential oils in this study also contain the major constituents (compounds) found in lavender essential oils reported by Taylor P, et al. and Kıvrak S (Figure 2).

Table 2: Chemical composition of local lavender.

S.N	Compound name	RT	PA
1	Beta-phellandrene	3.55	3.36
2	Beta-pinene	3.61	9.51
3	1,8-Cineole	4.76	38.5
4	Trans-β-terpineol	5.57	0.73
5	Linalool	6.52	0.74
6	Camphor	7.82	20.91
7	Endo-borneol	8.52	8.71

8	Trans-2,7-dimethyl-4,6-octadien-2-ol	8.58	1.98
9	Terpinen-4-ol	8.9	0.95
10	2-cyclohexen-1-one,4-(1-methylethyl)-	9.19	1.63
11	Alpha-terpineol	9.4	4.42
12	Alpha-thujenal	9.54	1.16
13	2-Cyclohexen-1-one, 4-(1-methylethyl)-	21.56	2.38
14	(+)-epi-bicyclosesquiphellandrene	26.28	1.67
15	Alpha-bisabolol	27.95	1.8
16	Adamantane	30.23	1.54

RT: Retention Time; PA: Peak Area

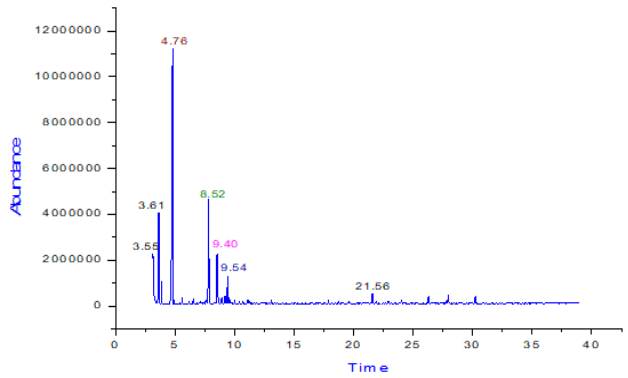

Figure 2: TIC chromatogram of local lavender.

Table 3 showed the comparison of compounds found in two lavender cultivars. As we have seen in the Table 3 most of the compounds found in both lavender cultivars are similar even if they differ in amount. However, some compounds which were found in one cultivar did not found in the other one. As we have seen in Table 3 some compounds like thujene, trans-beta-ocimene, and verbenone were found in only flowering lavender, and some compounds such as beta-phellandrene, trans-β-terpineol, alpha-bisabolol and adamantane were found only in local lavender.

Table 3: Comparison of chemical composition between flowering and local lavender essential oils.

SN	Compound Name	Flowering lavender		Local lavender	
		RT	PA	RT	PA
1	Thujene	3.55	1.23	ND	ND
2	Beta-phellandrene	ND	ND	3.55	3.36
3	β-pinene	3.61	5.48	3.61	9.51
4	Beta-thujene	3.87	0.64	ND	ND
5	1,8-Cineole	4.76	36.14	4.76	38.5
6	Trans-beta-ocimene	4.89	0.67	ND	ND
7	Trans-β-terpineol	ND	ND	5.57	0.73
8	Terpinolene	6.15	1.01	ND	ND
9	Linalool	6.53	0.91	6.52	0.74

10	Camphor	7.9	40.25	7.82	20.91
11	Endo-borneol	8.5	1.93	8.52	8.71
12	Terpinen-4-ol	8.91	0.83	8.9	0.95
13	Trans-2,7-dimethyl-4,6-octadien-2-ol	ND	ND	8.58	1.98
14	Alpha-terpineol	9.39	1.32	9.4	4.42
15	Benzenemethanol, alpha-2-cyclohexen-1-yl-	9.54	1.3	ND	ND
16	2-Cyclohexen-1-one, 4-(1-methylethyl)-	ND	ND	9.19	1.63
17	Verbenone	9.98	0.69	ND	ND
18	Alpha-thujenal	ND	ND	9.54	1.16
19	Caryophyllene	17.88	1.09	ND	ND
20	1,3-Cyclopentadiene, 1,2,3,4,5-pentamethyl-	ND	ND	21.56	2.38
21	Beta-caryophylleneoxide	24.04	2.74	ND	ND
22	(+)-epi-Bicyclosesquiphellandrene	26.29	1.38	26.28	1.67
23	Isooctyl alcohol	27.93	2.37	ND	ND
24	Alpha-bisabolol	ND	ND	27.95	1.8
25	Adamantane	ND	ND	30.23	1.54

CONCLUSION

From the GC-MS analysis, the essential oil compositions for two lavender cultivars were analyzed. Both cultivars contain major compounds found in lavender essential oils but differ in amount. Flowering lavender contains high camphor and low beta-thujene whereas local lavender contains high 1,8-cineole and low trans-beta-terpinol. Some compounds found in one cultivar didn't found in the other and vice versa. This shows there is little difference between the two cultivars. This study gives information for other works that will be done on lavender essential oil composition.

CONFLICT OF INTEREST

The authors should declare if exist or not conflict of interest with the data contained in the manuscript.

ACKNOWLEDGMENTS

We would like to acknowledge the Ethiopia institute of agricultural research, Wondo Genet agricultural research center the medicinal and aromatic plants research program, and the food science and nutrition laboratory for their technical support for this study.

REFERENCES

1. Cavanagh HMA, Wilkinson JM. Biological activities of lavender essential oil. Phytother Res. 2002;16;301–308.
2. Benabdelkader T, Zitouni A, Guitton Y, Jullien F, Maitre D, Casabianca H, et al. Essential oils from wild populations of Algerian *Lavandula stoechas* L.: Composition, chemical variability, and *in vitro* biological properties. Chem Biodivers. 2011;8(5):937-953.
3. Zheljazkov VD, Cantrell CL, Astatkie T, Jeliazkova E. Distillation time effect on lavender essential oil yield and composition. J Oleo Sci. 2013;62(4):195-199.
4. Gokdogan O. Determination of input-output energy and economic analysis of lavender production in Turkey. Int J Agric Biol. 2016;9(3): 154-161.

5. Hamada T, Yamaguch M. Evoked and oscillatory neuromagnetic responses to sniffing odor in human subjects. Behav Brain Res. 2001;123(2):219-223.
6. Katona JM, Sovilj VJ, Petrovic LB. Microencapsulation of oil by polymer mixture–ionic surfactant interaction induced coacervation. Carbohydr Polym. 2010;79(3):563-570.
7. Cassella S, Cassella JP, Smith I. Synergistic antifungal activity of tea tree (*Melaleuca alternifolia)* and lavender *(Lavandula angustifolia)* essential oils against dermatophyte infection. Int J Aromather. 2002;12(1):2-15.
8. Tanida M, Niijima A, Shen J, Nakamura T, Nagai K. Olfactory stimulation with scent of lavender oil affects autonomic neurotransmission and blood pressure in rats. Neurosci Lett. 2006;398(1-2):155-160.
9. Smigielski K, Raj A, Krosowiak K, Gruska R. Chemical composition of the essential oil of *Lavandula angustifolia* cultivated in Poland. J Essent Oil Bear PL. 2009;12(3):338-347.
10. Buchbauer G, Jirovetz L. Aromatherapy—use of fragrances and essential oils as medicaments. Flavour Fragr J. 1994;9(5):217-222.
11. Yang SA, Jeon SK, Lee EJ, Shim CH, Lee IS. Comparative study of the chemical composition and antioxidant activity of six essential oils and their components. Nat Prod Res. 2010;24(2):140-151.
12. Da Porto C, Decorti D, Kikic I. Flavour compounds of *Lavandula angustifolia* L. to use in food manufacturing: Comparison of three different extraction methods. Food Chem. 2009;112(4):1072-1078.
13. Kunicka-Styczynska A, Sikora M, Kalemba D. Antimicrobial activity of lavender, tea tree and lemon oils in cosmetic preservative systems. J Appl Microbiol. 2009;107(6):1903-1911.
14. Fakhari AR, Salehi P, Heydari R, Ebrahimi SN, Haddad PR. Hydro distillation-headspace solvent micro extraction, a new method for analysis of the essential oil components of Lavandula angustifolia Mill. J Chromatogr A. 2005;1098(2):14-18.
15. Muyima NY, Zulu G, Bhengu T, Popplewell D. The potential application of some novel essential oils as natural cosmetic preservatives in an aqueous cream formulation. Flavour Fragr J. 2002;17(4):258-266.
16. Costa P, Grosso C, Goncalves S, Andrade PB, Valentao P, Bernardo-Gil MG, et al. Supercritical fluid extraction and hydro distillation for the recovery of bioactive compounds from *Lavandula viridis* L Her. Food Chem. 2012;135(1):112-121.
17. Goncalves S, Romano A. *In vitro* culture of lavenders *(Lavandula* spp.*)* and the production of secondary metabolites. Biotechnol Adv. 2013;31(2):166-174.
18. Hanamanthagouda MS, Kakkalameli SB, Naik PM, Nagella P, Seetharamareddy HR, Murthy HN. Essential oils of *Lavandula bipinnata* and their antimicrobial activities. Food Chem. 2010;118(3): 836-839.
19. Tepe B, Daferera D, Sokmen A, Sokmen M, Polissiou M. Antimicrobial and antioxidant activities of the essential oil and various extracts of *Salvia tomentosa* Miller (Lamiaceae). Food Chem. 2005;90(3):333-340.
20. Pokajewicz K, Bialon M, Svydenko L, Fedin R, Hudz N. Chemical composition of the essential oil of the new cultivars of *Lavandula angustifolia* Mill. Bred in Ukraine. Molecules. 2021;26(18):5681.
21. 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. Afr J Microbiol. 2010;4(4):309-313.
22. Bialon M, Krzysko-Lupicka T, Nowakowska-Bogdan E, Wieczorek PP. Chemical composition of two different lavender essential oils and their effect on facial skin microbiota. Molecules. 2019;24(18):3270.
23. Yilmaz MA. Essential oil composition of lavandin (lavandula x intermedia) cultivated in Bismil-Turkey. Procedia Agric Econ. 2018;1(1):1120-1125.
24. Kıvrak S. Essential oil composition and antioxidant activities of eight cultivars of lavender and lavandin from western Anatolia. Ind Crops Prod. 2018;117:88-96.