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Research Article

Chemical Composition of the Essential Oils of Lavanda Cultivated in Herzegovina

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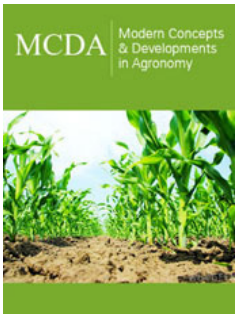

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Abstract

In this study, we analyzed the chemical composition of essential oils of two types of lavender cultivated in Herzegovina. Lavender essential oil was isolated by hydro distillation. Chemical characterization of individual components of essential oil was performed by gas chromatography GC-MS. The most ingredients of essential oil of *Lavanda angustifolia* are linalool (28.01%), linalyl acetate (27.59%), cis-β-ocimene (5.05), trans β-ocimene (4.09), terpinene-4-ol (4.86), lavandulyl acetate (5.90) i β-caryophyllene (3.93). The most ingredients of essential oil of *Lavanda sp* are: linalool (34.76%), linalyl acetate (27.59%), 1.8-cineole (3.21), camphor (6.93), borneol (4.05), α -terpineol (2.49), terpinene-4-ol (3.21), lavandulyl acetate (2.83) i β-caryophyllene (2.28).

Keywords: Lavender; Essential oil; Chemical composition

Introduction

Lavender is a perennial, aromatic plant from family Lamiaceae. It is used in medicine, food and cosmetics industry. Lavender is a plant of the Mediterranean region. It is produced in all areas with favorable conditions. Due to high temperatures, stony soil and a large number of sunny days, the area of Eastern Herzegovina provides ideal conditions for growing lavender. However, due to some ecological modification and adaptation of this species, lavender plantations can be found in continental areas, as well as at higher altitudes [1].

To date, 48 different species of lavender have been described. However, only the essential oil of *Lavandula angustifolia, Lavandula latifolia* and *Lavender* hybrid is used in the cosmetic industry [2]. Lavender essential oil contains about 100 active ingredients. The main ingredients of lavender essential oil are linalyl acetate and linalool. True lavender essential oil contains about 35-60% esters marked in linalyl acetate, while hybrid lavender essential oil contains only 7-16% esters [3].

Lavender essential oil is an excellent sedative, it has an effect on reducing bloating. It is often used as a corrector of the smell and taste of pharmaceutical preparations [1]. A large number of previous studies have confirmed that lavender essential oil has antioxidant, antimicrobial, anti-inflammatory properties [4-6]. Lavender essential oil is a mixed of chemical compounds with different antimicrobial properties. The antimicrobial effect of lavender essential oil depends on several active ingredients. Pharmacological and clinical evidence shows that the rational use of lavender essential oil works in chronic emotional disturbance [7]. Numerous authors have confirmed that lavender essential oil has a high inhibitor of cholinesterase activity [8,9].

Demand for lavender essential oil is on the rise, so lavender cultivation has been expanding over the past few years. The aim of this research is the chemical characterization of lavender essential oils from the area of eastern Herzegovina.

Material and Methods

Plant material

Plant material was collected in the phenophase of flowering in June 2020 in the area of Ljubinje in eastern Herzegovina. The plant material was dried in the shade on a draft. The dried plant material is packed in paper bags and stored in a dry and cool place.

Oil extraction

The essential oil was extracted by hydro distillation of dried plant material in a Clevenger apparatus according to the procedure prescribed by Ph. South. V [10]. During hydro distillation, the proportional ratio of plant material and water was 1:10 (m / v). The hydro distillation lasted for two hours. Extracted essential oil is a light yellow or colorless easily volatile liquid, with a pleasant smell, spicy and bitter taste. The results of determining the content of essential oil in the herb *L. angustifolia* represent the mean value of three comparative determinations.

Gas chromatography

We used a gas chromatograph HP 5890 with flame ionizing detector (FID), a column with HP-5MS stationary phase (25m x 0.32mm x 0.52mm) and an HP-GCD system with a column of the same polarity. Helium (chromatographic quality) was a carrier gas with rate of working of 1ml / min. Samples were analyzed in a splitless injector) (1:50).

The temperature of the injector was 250 °C, the detector 280 °C, and the column temperature was linearly programmed from 40 °C to 280 °C; 4 °C /min. Component identification was performed by comparing peak retention times with standard samples and their mass spectra, and by comparing the mass spectra of components with Wiley275 library data. The retention times of the determined components are correlated with the values of the Kovačević index for the DB-5 column, according to the data from the R. Adams spectrum library. The content of the components is given as the value of the percentage of areas (area%) obtained by integrating the peaks using FID detectors.

Climatic characteristics of the studied area

The study area is characterized by a sub-Mediterranean climate with mild winters and warm summers. The maximum temperature in summer is around 40 °C, while the minimum temperature in winter is around -5 °C. During the year, on average, about 1950mm of rain falls. In the geomorphological sense, the Ljubinje field is a typical karst field with a flat terrace. The experimental plot is a soil of neutral reaction, rich in nitrogen content, very rich in easily accessible phosphorus and very rich in potassium (Table 1).

Table 1: Land characteristics of the study area.

pH in 1M KCl	(N) %	mg K_2O/100g soil	mg P_2O_5/100g
6,91	0,28	74,6	50,6

Research Results with Discussion

Analysis of lavender essential oils indicated a variety of chemical components. The most common components of Lavender angustifolia essential oil were oxidized terpenes: linalool (28.01%) and linalyl acetate (27.59%). Other Less common components are: cis-β-ocimene (5.05%), trans β-ocimene (4.09%), terpinene-4-ol (4.86%), lavandulyl acetate (5.90%) and β-caryophyllene (3.93%). The results of our research are in accordance with the results of the research [11,12]. In the research of Bialon et al. [13], in Poland, a significantly higher percentage (41.8%) of linalool and linalyl acetate (32.7%) was identified. Different percentages of linalool, linalyl acetate and other constituents are probably due to different climatic conditions, which is in accordance with the research Stepić [11]. The author states that variations in the quantitative content of components are influenced by external factors. Kišgeci et al. [3] in their paper they conclude that variations in the quantitative content of components are influenced by external factors (Table 2).

Table 2: Chemical composition of essential oil in *Lavandula angustifolia*.

No.	RT	Compound	% of Compound of *L. angustifolia*
1	5.905	n.d.	0.6058
2	7.131	α - thujene	0.18303
3	7.319	α - pinene	0.31351
4	7.714	Camphene	0.15919
5	8.34	β-pinene	0.0868
6	8.5	octen-3-ol	0.41237
7	8.66	n.d.	0.82172
8	8.765	Myrcene	1.64012
9	8.889	n.d.	0.25061
10	9.194	n.d.	0.09129
11	9.383	α - phellandrene	0.92948
12	9.54	n.d.	0.10575

13	9.702	n.d.	0.9806
14	9.787	p-cimene	0.28842
15	9.907	Limonene	1.3912
16	10.001	1.8-cineole	1.08943
17	10.125	cis-β-ocimene	5.04869
18	10.443	trans-β-ocimene	4.09117
19	10.796	γ-terpinene	0.29329
20	11127	n.d.	0.06079
21	11.258	linalool oxide trans	0.07936
22	11.719	linalool oxide cis	0.20992
23	12.217	Linalool	28.01053
24	12.409	octenyl acetate	1.42674
25	12.799	n.d.	0.076
26	12.975	Camphor	1.06412
27	13.572	n.d.	0.51063
28	14.279	Borneol	2.52104
29	14.658	terpinene-4-ol	4.86248
30	14.814	n.d.	0.07166
31	14.95	Lavandulol	0.80402
32	15.081	α -terpineol	0.91159
33	16.236	n.d.	0.22312
34	16.655	n.d.	0.12202
35	17.125	linalyl acetate	27.59798
36	18.155	lavandulyl acetate	5.90925
37	20.418	neryl acetate	0.49852
38	20.844	n.d.	0.63338
39	21.008	geranyl acetate	0.93966
40	22.005	n.d.	0.04988
41..	22.21	β-caryophyllene	3.92367
42	22.605	trans-β-bergamotena	0.1416
43	22.19	trans-β-farnesene	1.73859
44	24.016	n.d.	0.56586
45	26.951	caryophyllene oxide	0.26286

The most common components of essential oil in *Lavandula sp.* were linalool (34.76%) and linalyl acetate (27.59%), and the less represented components were 1.8-cineole (3.21), camphor (6.93), borneol (4.05), α-terpineol (2.49), terpinene-4-ol 3.21), lavandulyl acetate (2.83) and β-caryophyllene (2.28). The same components with a similar percentage were found in both types of lavender (*Lavandula angustifolia, Lavandula sp.).* Similar results are published by other authors [11,14-16]. Different results are published by Maskovic et al. [17]. They found a significantly higher percentage of linalool (54.24%) and a very low percentage of linalyl acetate (0.77%) in lavender essential oil (Table 3).

Table 3: Chemical composition of essential oil in Lavandula sp.

No.	RT	Compound	% of Compound
1	7.139	α - thujene	0.04039
2	7.326	α - pinene	0.32852
3	7.719	Camphene	0.1784
4	8.346	β-pinene	0.05371
5	8.454	octen-3-ol	0.43099
6	8.769	Myrcene	1.53083

7	9.366	α - phellandrene	0.13017
8	9.546	α - terpinene	0.05819
9	9.792	p-cimene	0.455
10	9.903	limonene	0.78147
11	10.01	1.8-cineole	3.20934
12	10.119	cis-β-ocimene	0.93665
13	10.439	trans-β-ocimene	0.88457
14	10.801	γ-terpinene	0.13978
15	11.261	linalool oxide trans	0.0852
16	11.721	linalool oxide cis	0.41507
17	12.241	linalool	34.75992
18	12.309	n.d.	0.14046
19	12.409	octenyl acetate	0.27597
20	12.979	n.d.	0.2245
21	13.61	camphor	6.92804
22	14.32	borneol	4.04786
23	14.653	terpinene-4-ol	3.20865
24	14.97	lavandulol	0.25599
25	15.094	α - terpineol	2.4968
26	16.555	n.d.	0.44502
27	17.115	n.d.	0.09913
28	17.115	linalyl acetate	23.09242
29	18.139	lavandulyl acetate	2.82501
30	19.388	n.d.	0.10266
31	20.42	neryl acetate	0.84971
32	21.014	geranyl acetate	1.64449
33	21.232	n.d.	0.07557
34	21.698	n.d.	0.09527
35	22.201	β-caryophyllene	2.28564
36	22.608	trans- α -bergamotena	0.19789
37	22.826	n.d.	0.05165
38	22.19	trans-β-farnesene	1.50971
39	23.417	n.d.	0.14769
40	23.661	n.d.	0.11806
41	24.018	n.d.	0.93373
42	24.537	n.d.	0.10174
43	24.727	n.d.	0.88619
44	24.958	n.d.	0.40331
45	25.19	n.d.	0.42248
46	26.948	caryophyllene oxide	0.14409
47	28.515	n.d.	0.64455
48	29.625	n.d.	1.29699

The quantitative composition of essential oils depends on the method of cultivation of lavender, altitude and microclimatic conditions [18,19].

Conclusion

The analysis of lavender essential oils from the area of eastern Herzegovina indicated the diversity of chemical constituents in them. The percentage of components was similar in both types of lavender. The most common components of the tested lavender essential oils are oxidized terpenes: linalool, linalyl acetate, cis-β-ocimene, trans β-ocimene, terpinene-4-ol, lavandulyl acetate, β-caryophyllene, 1.8-cineole, camphor, borneol and α-terne.

Although there are data on the composition of lavender essential oils in the literature, the obtained results are significant in terms of evaluating the quality of essential oils of the tested species from the territory of Herzegovina.

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