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GC/MS Analysis of Herbage Essential Oil from Lemon Balms (*Melissa officinalis* L.) Grown in Turkey

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ABSTRACT

This study was carried out to investigate the content and chemical composition of essential oil from lemon balm (*Melissa officinalis* L., Labiatae) grown in Turkey. The water-distilled essential oil from aerial parts of plants was analyzed by GC/MS. The essential oils of plant materials investigated ranged from 0.04 to 0.10%. Citronellal (36.62 to 43.78%), citral (10.10 to 17.43%), thymol (0.40 to 11.94%), and *β*-caryophyllene (5.91 to 7.27%) were recorded as major components.

Key Words: *Melissa officinalis*, essential oil, GC/MS, citronellal, citral

INTRODUCTION

Lemon balm (*Melissa officinalis* L., Labiatae) is a perennial herb, and cultivated commercially in southwestern, central and eastern Europe [1,2]. Lemon balm populations are distributed in all Mediterranean countries including the coastal regions of Turkey [3].

There are three subspecies of *M.officinalis* subsp. *officinalis*, subsp. *inodora* and subsp. *altissima*; however, only subsp. *officinalis* has commercial value and the characteristic lemony odor of lemon balm. Because the essential oil rate of lemon balm is quite low, the production cost and price of the oil are very high. Therefore, lemon balm oil is sometimes adulterated with Cymbopogon spp. or Citrus pile oil [4].

Lemon balm is used for several purposes such as an additive in food, an herb tea, an ingredient in cosmetics, an ornamental and a medicine. An aromatic, cooling, sedative herb that lowers fever, improves digestion, relaxes spasms and peripheral blood vessels, and inhibits thyroid activity [2]. It has anti-viral, anti-bacterial, and insect-repellent effects [5]. Also, lemon-scented leaves of plant have been used as seasoning. Generally, aerial parts of lemon balm contain at least 0.05% of essential oil (a complex mixture of monoterpenoids and sesquiterpenoids).

The main component of essential oil is citronellal (about 30-40%), together with 10-30% citral. Citral actually comprises two compounds, citral a (geranial) and citral b (neral) in a ratio of 4:3. Major sesquiterpenoids include germacrene D and *β*-caryophyllene [2].

The aim of this work was to examine the content and chemical composition of essential oil from the herbage (aerial parts) of some lemon balm lines grown in Turkey.

MATERIALS AND METHODS

This study was carried out at laboratories and experimental field of Field Crops Department, Faculty of Agriculture of Ankara University in 2007-2008 years.

Plant Material

The aerial parts or herbage of three lemon balm lines were collected from the experimental field of the same department on 25 October 2007.

Essential Oil Analysis

The collected plant parts were dried in the shade at room temperature. Average 50 g of these parts were ground and subjected to hydrodistillation for 3 h in 500 ml water using a Clevenger-type apparatus.

Chromatographic (GC/MS) Analysis

The essential oil was analyzed by GC-MS. The analysis was performed using a Hewlett Packard 6890 N GC, equipped with HP-5 MS capillary column (30 m x 0.25 µm) and HP 5973 mass selective detector. For GC-MS detection an electron ionization system with ionization energy of 70 eV was used. Helium was carrier gas, at a flow rate of 1 ml/min. Injector and MS transfer line temperatures were set at 220 and 290 °C, respectively. Column temperature was initially kept at 50 °C for 3 min, then gradually increased to 150 °C at a 3 °C/min rate, held for 10 min and finally raised to 250 °C/min. Diluted samples (1/100 in acetone, v/v) of 1.0 µl were injected automatically and in the splitless mode [6]. Individual components were identified by spectrometric analyses using computer library.

RESULTS AND DISCUSSION

The herbage from lines investigated gave dark yellowish oil. The essential oil contents obtained were 0.10% in Line-8 and Line-11, and 0.04% in Line-72. In previous studies, the essential oil obtained from the aerial parts of *M. officinalis* L. ranged from 0.03-0.47% [7-12].

The results obtained in the qualitative and quantitative analysis of the investigated essential oils are given in Table 1. The components having the value of >5% were evaluated as the major ones. 33 components in Line-8 oil, 17 components in Line-11 oil, and 24 components in Line-72 oil, representing 83.73%, 83.43%, and 84.55%, respectively, were identified (Table 1). In our study, citronellal, citral, thymol, and *β*-caryophyllene were major components (Figure 1). For all lines, the component with highest value was citronellal (37.33% in Line-8, 43.78% in Line-11, and 36.62% in Line-72). In previous studies, the content of citronellal measured varied from 5.51% to 43.8% [9,11-18]. Similarly to our results, it was stated that the major components in cultivated *M. officinalis* oils are aldehydes such as citronellal, neral and geranial, whereas sesquiterpenes such as (*E*)-caryophyllene and caryophyllene oxide have also been important compounds [5].

Thymol recorded in the essential oil of Line-8 (11.94%) was higher than the one in the essential oils of Line-11 (0.40%) and Line-72 (1.97%). The ratio of thymol was ranged 7.9% to 10.5% in the study carried out by Askari and Sefidkan [12]. On the other hand, this component was found trace amount or not any in the lemon balm essential oils investigated in some studies [5,11,17].

The other important component of the essential oils from lines was 1,3,8-p-menthatriene (7.22% in Line-8, 11.05% in Line-11, and 12.70% in Line-72). Contrary to our results, this component was found trace amount (<0.05%) in the lemon balm essential oil [5].

The essential oils investigated in our study displayed quantitative and some qualitative differences. Similarly, Van de Berg et al. [19] have identified the main components of the leaf oils of cultivated *M. officinalis* subsp. *altissima* of Greek origin as *β*-caryophyllene (7.27-12.66%), germacrene D (34.79-51.50%), sabinene (0.91-14.68%) and *β*-pinene (0.53-8.03%). These compounds have also been detected as the main ones in the studied *Melissa* oils of Greek origin from natural populations, whereas no citral or citronellal was detected.

When the our results were compared with the literature, the chemical composition and content of essential oil from *M. officinalis*, similarly other medicinal plants, in the present study showed significant differences, which can be attributed several factors, such as the part of plant under analysis, the stage of plant development, the time of harvesting or picking, differences in climatic and ecological conditions, and the different distillation methods used in the studies etc. [12,20].

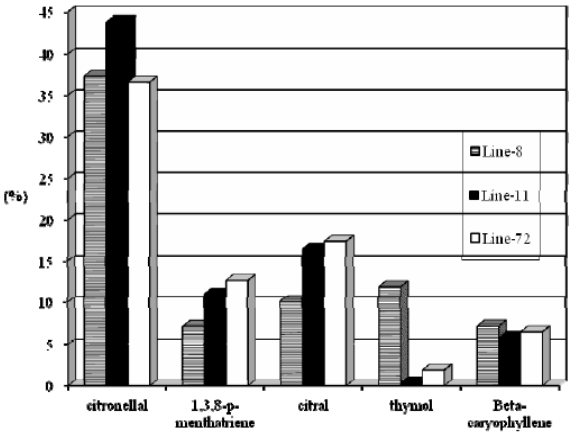

Figure 1. Comparison of major components in three essential oils (%)

Table 1. Chemical compositions (%) of essential oil from aerial parts of lemon balm lines

Peak	Components	RT	Line-8	Line-11	Line-72
1	1-Octen-3-ol	10.52	0.40	0.13	0.31
2	Myrcene	11.02	0.07	-	-
3	*p*-Cymene	12.45	0.13	0.20	0.16
4	Limonene	12.63	0.06	-	-
5	Eucalyptol	12.73	0.11	-	0.18
6	1,3,6-Octatriene	13.60	0.15	-	0.29
7	2,6-Dimethyl-5-heptanal	13.85	0.15	0.17	0.23
8	*γ*- Terpinene	14.01	0.25	0.15	0.26
9	Linalool	14.03	3.05	3.60	3.69
10	3-Methyl-2-(2-methyl-2-butenyl)	15.87	-	-	0.10
11	*β*-Thujone	16.20	0.27	-	0.41
12	Rose oxide (cis)	16.49	0.18	-	-
13	5-Hepten-1-ol	17.40	0.13	0.22	-
14	Bicyclo[2.2.1]heptan-2-one	17.96	0.06	-	0.09
15	Isopulegol	18.05	0.54	0.42	0.49
16	Trans-chrysanthemal	18.27	0.34	0.19	-
17	**Citronellal**	**18.67**	**37.33**	**43.78**	**36.62**
18	Citronella	18.80	0.23	-	-
19	Isoborneol	19.04	0.21	-	-
20	Bicyclo[3.1.1]heptane	19.42	0.11	-	-
21	Citronellol	22.01	0.29	0.57	0.59
22	1,3,8-p-Menthatriene	22.58	7.22	11.05	12.70
23	Citral	23.97	10.10	16.50	17.43
24	3,6-Octadienoic acid	24.16	0.16	-	-
25	Bicyclo[2.2.1]heptan-2-oI	24.53	-	-	0.39
26	Thymol	24.96	11.94	0.40	1.97
27	Carvacrol	25.30	0.97	-	0.14
28	2,6-Octadienoic acid	26.24	-	0.58	0.61
29	Citronellyl butyrate	27.55	0.10	-	-
30	*β*-Caryophyllene	30.27	7.27	5.91	6.60
31	*α*-Humulene	31.63	0.42	0.29	0.39
32	Germacrene-D	32.78	0.26	-	0.25
33	*β*-Ionone	33.01	0.09	-	-
34	*β*-Bisabolene	33.93	0.15	-	-
35	*α*-Muurolene	36.51	0.70	-	0.48
36	Neophytadiene	46.14	-	0.27	0.17
37	(+)-Aromadendrene	47.12	0.29	-	-
	Amount of Identified Compounds		**83.73**	**83.43**	**84.55**
	Essential Oil Ratio (%)		**0.10**	**0.10**	**0.04**

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