CHEMICAL COMPOSITION OF LAVENDER OIL PRODUCED FROM LAVENDER CULTIVATED IN THE SOUTH OF MADRID

S. SMETAN[1]; Dana COPOLOVICI[2]; Ilinca Merima IMBREA[1]; Gabriela Valentina CIOBOTARIU[1]; L. COPOLOVICI[2]; Georgeta, POP[1].

[1] Banat's University of Agricultural Sciences and Veterinary Medicine „King Michael I of Romania" from Timisoara, Romania;
[2]Aurel Vlaicu University, Faculty of Food Engineering, Tourism and Environmental Protection; Institute for Research,
Development and Innovation in Technical and Natural Sciences, Romania, 2 Elena Drăgoi St., Arad, 310330, Romania

E-mail: stefansmetan@gmail.com

Abstract. *Chemical composition of lavender oil (Lavandula angustifolia L), produced from lavender cultivated on the experimental site of Morata (Table 1). Lavender inflorescences contain linalool as a major compound. In addition, the chemical composition is influenced by the environmental factors of the growing and blooming period of plants (HASSIOTIS et al., 2014; KIRAN, and BHANU, 2015). We identified 21 compounds in the volatile oils of Lavandula angustifolia L., out of which 14 major compounds (at a concentration of over 0.2%) accounted for 99.53% of the total number of compounds. The remainder of the chemical compounds was found in an amount less than 10% of the total amount. Our results are consistent with other studies on the composition of Lavandula angustifolia L. oil (DUDA et al., 2015, VERMA et al., 2010; DA PORTO et al., 2009). The experimental results obtained in 2016 showed that two chemical compounds, with the highest values, dominate the chromatographic profile of lavender essential oil presented in Table 1: linalool 21.28% and linalyl acetate 18.84%. These major compounds, linalool 21.28% and linalyl acetate 18.84%, are representative compounds of lavender essential oil.*

Keywords: *lavender, essential oil, chemical composition*

INTRODUCTION

Lavender (*Lavandula angustifolia Mill*.) is an aromatic plant with versatile use due to its medicinal effects and its diverse use. It can also be grown as an aromatic decorative plant for landscape purposes, but also because it prevents soil erosion and can be planted on steep, sunny and calcareous slopes with southern exposure, away from strong winds. Volatile oil obtained by distillation of inflorescences has wide uses in: perfume industry - in concentrations up to 1.2%, aromatherapy and integrative medicine, cosmetics industry - cologne, ointments, lotions, deodorants, soaps and detergents, pharmaceutical industry, food industry.

Dry inflorescences, due to volatile oil and its components, get into *tea* formulas or can be processed as infusions, tinctures, oils, inhalations, general and feet baths. It can also be used as an insect repellent or as an aromatic addition. According to HMPC 2012 and EMA/HMPC/143183/2010, lavender flowers contain: 1-3% ethereal oil; dried flowers may contain up to 7% of coumarin derivatives; flavonoids - antioxidant action; traces of sterols: cholesterol, campesterol, stigmasterol, β-Sitosterol; triterpene traces: mictomeric acid, ursolic acid; tannins up to 13% of the plant – astringent action; phenylcarboxylic acids such as rosmarinic acid, ferulic acid, isoferulic acid, α-Coumaric acid, p-Coumaric acid, gentisic acid, p-OH benzoic acid, caffeic acid, melilotic acid, sinapinic acid, syringic acid, vanillic acid.

According to the same source, the main compounds of Lavandula angustifolia essential oil are monoterpene alcohols (60-65%) as well as linalool (20-50%) and its esterified fraction: linalyl acetate (25-46%). Other fractions include: cis-Ocimene (3-7%), terpinen-4-ol (3-5%), limonene, cineole, camphor, lavandulyl acetate, lavandulol and α-terpineol, β-caryophyllene, geraniol, α-pinene. The non-terpenoid aliphatic compounds are: 3-Octanone, 1-Octen-3-ol, 1-Octen-3-yl acetate, 3-Octanol (ESCOP 2009; HÄNSEL ET AL 1993; BRUNETON 1999).

GHE. V ROMAN also mentions the existence of other "valuable compounds such as: free alcohols (geraniol, nerol, lavandulol, borneol, citronellol), their esters as geraniol acetate, bornyl acetate, acids, phenols, aldehydes and many more". Volatile oil from Lavandula angustifolia has been considered a natural remedy for various diseases for centuries.

Author PAUN E.1995 attributes to lavender essential oil the following actions: sedative on the central nervous system, antiseptic, healing and carminative, and VERZEA MARIA 2001 presents the effects: choleretic, collagogue and diuretic.

Lavender volatile oil contains over 100 fractions analysed GC-MS in the study year. Only major compounds are highlighted: 18, respectively 22.

The linalyl acetate fraction of lavender essential oil is attributed sedative and calming properties, and the linalool fraction confers antibacterial, antispasmodic, anxiolytic, anti-insomnia and anti-oxidant properties of lavender. Research shows that essential oils work by means of the synergy of the fractions that make it up.

MATERIAL AND METHODS

The biological material was used, the seedlings produced by Semiflor, Alicante province, Spain, and on October 10th they were planted in the experimental field. Lavandula angustifolia L. (Fig 1 a, b) For the production of essential oil, the harvesting of flowers is optimal when approximately 75% of the flowers are open, the content of volatile oil being maximum. The harvesting of flowers begins when about 50% are opened up to 100%. To obtain a maximum level of oil production, the lavender flowers are mainly harvested in the 10-14-hour range. The technology applied was the current one

a b

Fig. 1 a,b. *Lavandula angustifolia L*

The oils were obtained during hydro-distillation for 1.5 hours by means of a 100-liter alabaster installation. The essential oil was collected and stored in dark glass bottles at a temperature of 12°C until use.

RESULTS AND DISCUSSIONS

The average chemical composition of samples V1, V5 and V11 EO (Lavandula angustifolia L) compared to the control sample V6 EO from 2016 is presented in Table 1. Components 22 were identified in the EO obtained from L. angustifolia Miller, representing 99.9% of the total, the major components being caryophyllene 24.12%, beta-phellandrene 16% and eucalyptol (1,8-cineol) 15.69%.(JIANU ET AL. – 2013)

With concentrations over 3% in the oils extracted under their own experimental conditions were identified: lavandulyl acetate 9.22% and trans-β-Ocimene 6.479% (cis-β-Farnesene 3.860%, Terpinen-4-ol 3.811%, and Carvacrol 3.333%). The following chemical compounds were found with values above 2%: cis-β-Ocimene 2.477%, τ-Cadinol 2.473%, endo-Borneol 2.23%, Eucalyptol 2.144%, α-Terpineol 2.130%.

Table 1

No.	RT (min)	Compounds	Control V6 (%)	Average V1, V5, V11 (%)
1	10.836	trans-β-Ocimene	2.033	6.479
2	14.876	Linalool	21.151	21.28
3	17.589	endo-Borneol	3.005	2.29
4	18.043	Terpinen-4-ol	4.695	3.71
5	18.59	α-Terpineol	2.749	2.205
6	21.202	Linalyl acetate	22.942	18.84
7	22.22	Lavandulyl acetate	10.994	9.22
8	26.35	diphenhydramine	8.803	7.23
9	27.255	cis-β-Farnesene	2.932	2.97
10	28.742	γ-Cadinene	2.861	2.006
11	31.771	τ-Cadinol	3.008	2.61
12		Eucalyptol		2.40
13		β-Ocimene		2.81
14		Carvacrol		3.45
15		Trans-2-menthenol		2.66

From the graph illustrated in Figure 2, we notice that the main compound in volatile oil is linalool 22.11%, followed closely by the second major compound linalyl acetate 20.384%, the two compounds together totalling 42.49%. The other compounds of the volatile oil are found in the following proportions: lavandulyl acetate 7.599%, diphenhydramine 7.31%, Trans-β-Ocimene 5.976%, Cis-β-Farnesene 3.86%, Terpinen-4-ol 3.811 %, Carvacrol 3.333%. With the lowest values are the following compounds: cis-β-Ocimene 2.47%, Cadinol 2.473%, endo-Borneol 2.23% and α-Terpineol 2.13%.

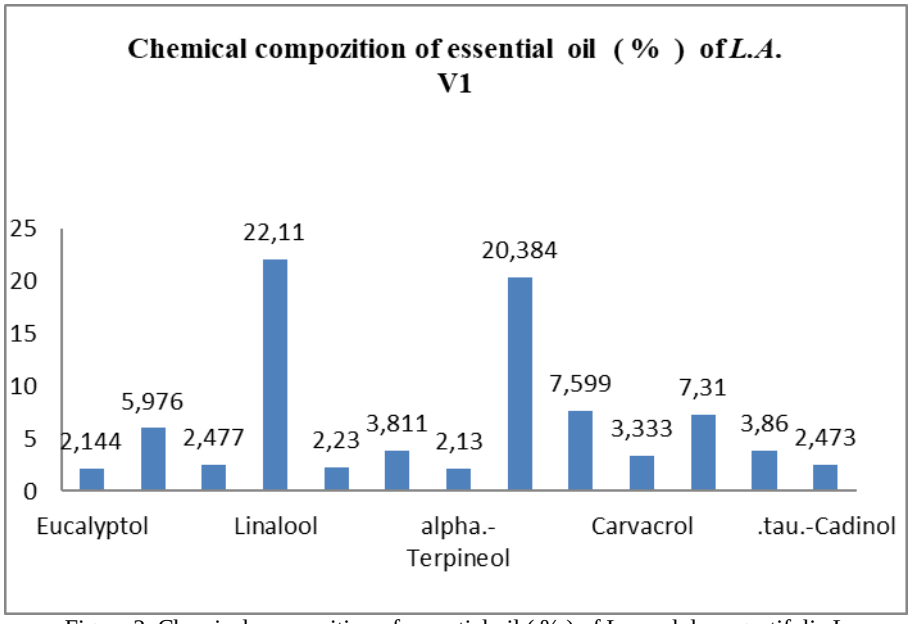

Figure 2. Chemical composition of essential oil (%) of Lavandula angustifolia L

The chemical composition of the lavender essential oil is shown in Figure 3: the main compound is linalool 22.29%, followed closely by linalyl acetate 18.86%, together totalling 41.15%. The other compounds of the volatile oil are found in the following proportions: lavandulyl acetate 10.45%, diphenhydramine 7.256%, trans-β-Ocimene 6.893%, Cis-β-Farnesene 3.86%, Terpinen-4-ol 3.94%, Carvacrol 3.578%. With the lowest values are the following compounds: cis-β-Ocimene 3.126%, Cadinol 2.553%, endo-Borneol 2.432% and α-Terpineol 2.478%.

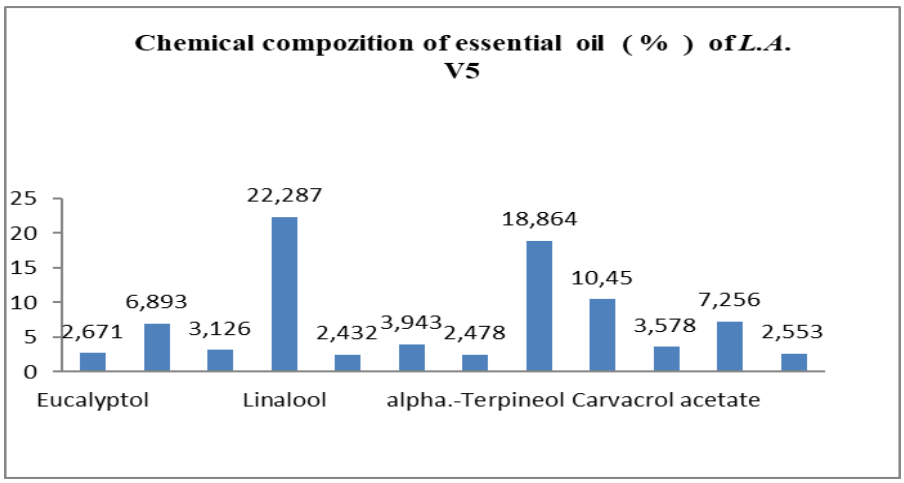

Figure 3. Chemical composition of essential oil (%) of *Lavandula angustifolia L*

From Figure 4 one can notice that the main compounds of lavender essential oil are linalool 19.44% and linalyl acetate 17.32%, together totalling 36.76%. The other compounds in the volatile oil are found in the following proportions: Lavandulyl acetate 9.619%, Diphenhydramine 7.134%, trans-β-Ocimene 6.568%, Terpinen-4-ol 3.368%. Seven compounds have values close to 2%: β-Ocimene 2.803%, Cadinol 2.834%, Thymol 2.109%, Cis-β-Farnesene 2.098%, γ-Cadinene 2.006%, endo-Borneol 2.209% and α-Terpineol 2.007%.

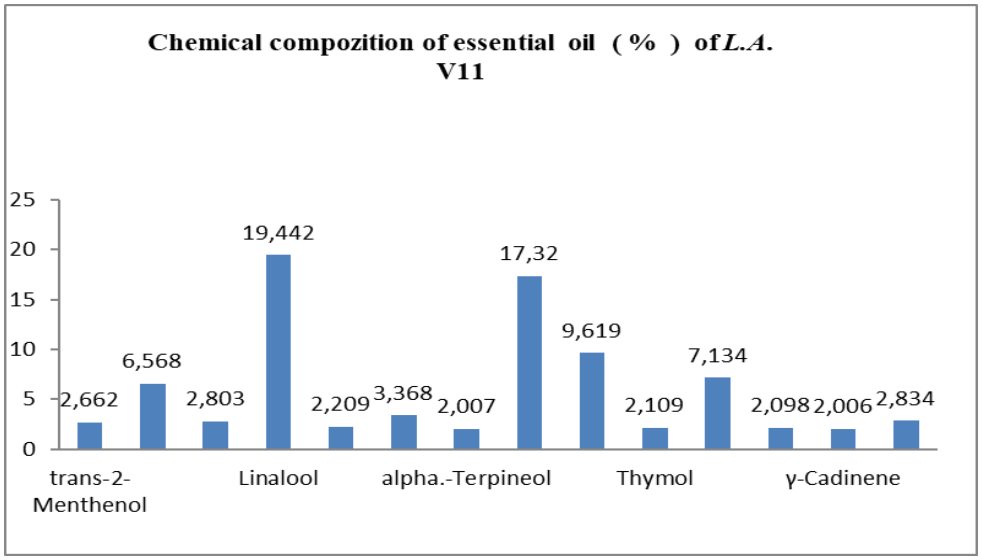

Figure 4. Chemical composition of essential oil (%) of *Lavandula angustifolia L.*

Figure 5 shows the chemical composition of the lavender essential oil, of which we remark: linalyl acetate 22.942%, lavandulyl acetate 10.99% and diphenhydramine 8.803%. Chemical compounds in volatile oil are found in smaller quantities in variant V6: Terpinen-4-ol 4,695%, τ-Cadinol 3,008%, γ-Cadinene 2,861% and α-Terpineol 2,749%.

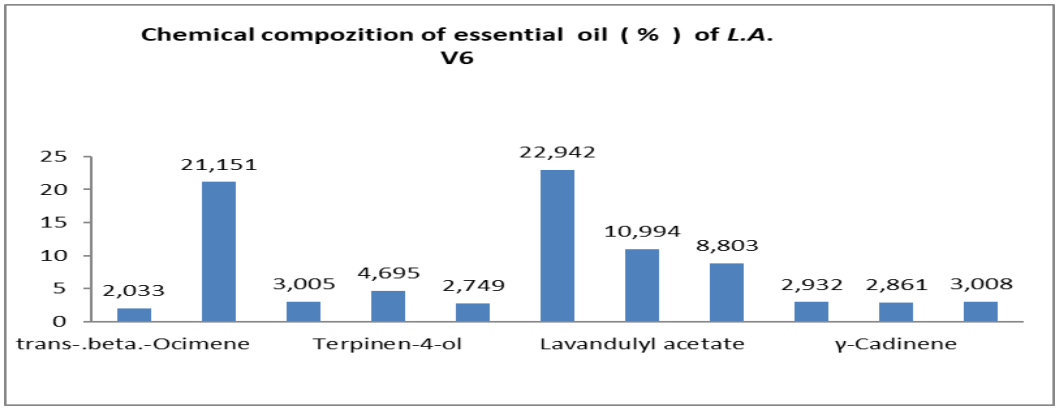

Figure 5 Chemical composition of essential oil (%) of *Lavandula angustifolia L.*

In plot V6 there were no herbicides applied, it being the control plot. In the other plots V11, V5 and V1 the weed control was carried out and therefore the chemical composition of the oil was different, both the proportion of the compounds and their structure were modified.

CONCLUSIONS

However, the partial conclusion regarding the quality of the essential oil is promising and remains to be followed in the coming years if this characteristic is maintained or was a feature of 2016. Following the gas chromatograph and mass spectrometry analyses, the results show that the main fractions of lavender oil linalool and its fraction esterified linalyl acetate in the study year 2016 are in the following proportions:

- the fraction of linalyl acetate of the essential oil is in the range 17.32-20.38 compared to the reference range 25.6-28.4%, which signifies a certain quality for the lavender essential oil, while the linalool fraction maintains within the reference range 22.2-31.6%, reaching the value of 22.11 - 22.29%.

The lavender essential oil obtained in 2016 is a balanced oil having in the chemical composition the two important fractions for various therapies.

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