Essential Oil Composition in Three Cultivars of *Ocimum basilicum* L. in Albania

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Abstract

Basil is an important medicinal and aromatic plant that is used in many fields. This paper presents quantitative and qualitative analyses of essential oils obtained from one autochthonous cultivar of *Ocimum basilicum L.* and two Italian cultivars, *Ocimum basilicum L. cv.* Purple, *Ocimum basilicum L.* Green with wide leaves. Study was carried out during 2011 at the Botanical Garden of the Agricultural University of Tirana, Albania. The cultivars displayed diversity of morphological, biological and economic characteristics. The cultivars of purple-leafed were judged to be the most decorative. The analyses for essential oil compositions are carried out on Shimatzu 20-10, GC-MS. In the volatile oil of *O. basilicum L. cv.* Green wide leaves, twelve components were characterized, representing 90% of the total oil. *Linalool* (45.3%) and *Eugenol* (42.06%) were the major components. In the volatile of *O. basilicum L. cv.* Purple, nine components were characterized representing 90% of the total oil. *Farnesene* (14.94%), *Elemol* (11.29%) and *Carvacrol* (9%) were the major components. In the *O. basilicum L.* autochthonous cultivar with green narrow leaves, twelve components were characterized representing 90% of the total oil. *Linalool* (48%) and *Eugenol* (36.09%) were the major components. *Linalool* is dominant constituent in the two cultivars, even though there was a big difference between two green cultivars with different leaves morphology on their oils contents. These results suggest that further research to improve the quality of the essential oil content is necessary.

KEYWORDS: essential oil, GC-MS, linalool, *Ocimum basilicum L.*

INTRODUCTION

Basil is an important medicinal and aromatic plant of the *Lamiaceae* Family that is used in many fields. Family *Lamiaceae* is a pleasant by smelling perennial shrub which grows in several regions all over the world. Basil is one of the species used for the commercial seasoning. It is commonly known that the presence of essential oils and their composition determine the specific aroma of plants and the flavor of the condiments. The genus *Ocimum* is characterized by great variability among the specifics including morphology, the color of flowers, leaves and stems, and chemical composition. Different authors have grouped basil into sub genus based on their chemical composition or to the morphology (Chiang and Cheng, 2005; Moudachirou *et. al.,* 1999). The leaves and flowering crops of sweet basil are used as stomachic and antispasmodic

medicinal plant in folk medicine (Chiej, 1988; Duke, 1989).
There are many cultivars of basil which vary in their leaf color (green or purple), flower color (white, red, purple) and aroma (Morales and Simon, 1996). The cultivars of purple-leafed were judged to be the most decorative. *Ocimum* spp. contain a wide range of essential oils rich in phenolic compound and a wide array of other natural products including polyphenols such as flavonoids and anthocyanins (Jirovetz and Buchbauer, 2001; Phippen and Simon, 1998). The chemical composition of basil oil has been the subject of considerable studies. There is extensive diversity in the constituents of the basil oils and several chemo types have been established from various phytochemical investigations (Simon *et. al.,* 1990). However, Linalool, Eugenol, Farnesene, Elemol, are reported as major components of the oils of different chemotypes of *O. basilicum* (Grayer *et. al.,* 1996; Marotti *et. al.,* 1996; Chalchat *et. al.,* 1999). *Linalool* (Raguso and Pichersky, 1999) is dominant constituent in the two green and purple cultivars, with different leaves morphology, on their oils contents. The morphological development of cultivars was observed to assess the best time to harvest for aromatic and medicinal purposes (Svecova and Neugebauerova, 2010). The essential oil content was examined qualitatively and quantitatively to assess the potential of cultivars for industrial use (Svecova and Neugebauerova, 2010). In the last few decades the importance of basil as an ornamental plant has grown and the number of cultivars on sale has increased significantly, it is now available in a wide range of habits, colors and flavors. Apart from their ornamental value, these cultivars may also be rich in essential oils and could offer a new source of oil for industrial exploitation (Svecova and Neugebauerova, 2010). Only a few articles about basil have focused on essential oil levels and its composition, and also on morphological characteristics, as well (Kasali *et al.,* 2004; Morales, 1996; Keita *et. al.,* 2000; Moudachirou *et. al.,* 1999; Sanda *et. al.,* 1998).
The present study describes the composition of essential oils of three basils cultivated in botanical garden near Agricultural University of Tirana, Albania. This is the first study of an *Ocimum* oil contents and emphasizing morphological characteristics. The aim was not only to evaluate basil cultivars according to their essential oil content and composition, but also to distinguish their ornamental value.

MATERIALS AND METHODS

Experimental design. The plants were cultivated in Botanical garden of the Agricultural University of Tirana, Albania. Mean temperature from April to July was 18^{o}C and 200 mm of rainfall. A drip-irrigation system was installed to provide water when necessary.
The plants were planted out in the field 40 to 45 days after germination. Each cultivar was represented by 20 plants. The distance between the plants was 0.4 m in the rows and 0.6 m between the rows. Plants were harvested at the beginning of flowering from the middle of June to the end of July in 2011. The plants were identified at the Botany Department of the Faculty of Agriculture and Environment, Tirana, Albania. GS-MS method was used for laboratory analyses. The lab analyses were carried at the Institute of Veterinary of Tirana.
Isolation of the essential oils. The essential oils were isolated by hydro distillation, using a Clevenger type apparatus. The distilled oils were dried over anhydrous sodium sulfate and stored in tightly closed dark vials at 4°C until the analysis was performed. Analysis GC-MS analysis was carried out on a Shimatzu 20-10, gas chromatograph fitted with a fused silica HP-5MS capillary volume (30 m x 0.25 mm; film thickness 0.25µm). The oven temperature was programmed from 60°-280°, Ratio 4°C/min. Helium was used as a carrier gas at a flow rate of 2 mL/min. The gas chromatograph was coupled to a Shimatzu 20-10 mass selective detector. The MS operating parameters were ionization voltage, 70 eV, and ion source temperature was

300°C.
Identification of components of the volatile oils were based on retention index and computer matching with the Wiley 275.L library, as well as by comparison of the fragmentation patterns of the mass spectra with those reported in the literature (Adams, 1995; Swigar *et. al.,* 1981). Retention indices (RI) values were measured on HP-5MS column. For RI calculation, a mixture of homologues *n*-alkenes (C9-C19) was used, under the same chromatographic conditions which were used for the analysis of the essential oils.

RESULTS AND DISCUSSION
Plants had prevalently plain leaves in the medium and small green-leafed and purple-leafed cultivars. In the narrow green-leaved cultivars most leaves were undulate with small or sparse blisters. Flower size was intermediate. In the purple-leafed cultivars the calyx and corolla were in various shades of purple, and in this cultivar the calyx was pubescent. The beginning of the flowering varied from 19 to 60 days after planting. The cultivars which were the latest to initiate flowering were *O. basilicum* with wide leaves (Figure 1).

Figure 1. Three *Ocimum basilicum L.* cultivars under study: a) Cv. Wide leaves, b) Purple basil, and c) Narrow leaves.

Chemical compositions of the essential oil of *Ocimum basilicum L.* are given in Table 1 in the order of the retention times of the constituents. Twelve components of the oil of *O. basilicum L.cv.* green wide leaves, nine components of the oil of *O. basilicum L. cv*. Purple and twelve components of the oil of *O. basilicum L. cv.* Green narrow leaves, were identified. The main components in the *Ocimum* with wide leaves were Linalool (45.03%), representing the most important compound in the genus, followed by Eugenol (42.06%). In the oils, obtained from aerial parts of *O. basilicum* grown in Colombia and Bulgaria, linalool is reported as a major component of volatile oils respectively (14.15%) (Vina and Murillo, 2003; Benitez *et. al.,* 2009; Jirovetz and Buchbauer, 2001). Nine components of *O. basilicum L.cv* purple were identified and the main constituents are *Farnesene* (14.94%), *Elemol* (11.29%) and *Carvacrol* (9%), consulting with literature geraniol and methyl chavicol are the main components in the oil of *O. basilicum L.cv.* purple in Turkey and Iran (Özcan and Chalchat, 2002; Sajjadi 2006). In the *O. basilicum L.cv* green narrow leaves (autochthonous cultivar), twelve components were identified and the main components were *Linalool* (48%) and *Eugenol* (36.09%) (Table 1).
These results showed that *O. basilicum* L. Green narrow leaves (autochthonous cultivar) is the most interesting species from the economic point of view. Lawrence (1988) has proposed several chemo types based on the composition of the essential oils. For determination of probable chemo types, further investigations would be required. The observed differences may

be probably due to different environmental and genetic factors, different chemo types and the nutritional status of the plants, as well as other factors that can influence the oil composition. The results of this study indicate that the composition of volatile oil of cultivars cultivated in Albania was similar to those which are reported from Iran (Sajjadi, 2006) and Turkey (Özcan *et. al.,* 2002).

Table 1. Essential oil composition of three *Ocimum basilicum L.* cultivars under study

№	Compounds	Retention time (min)	Composition (%)		
			Wide leaves	Purple basil leaves	Narrow
1	*Thymol*	2.859	1.81	2.93	0.99
2	*Carvacrol*	2.943	4.31	9.00	4.36
3	*Trans- Caryophyllene*	3.280	7.58		6.66
4	*Linalool*	5.059	45.3		48.00
5	*Farnesene*	6.578	1.58	14.94	1.05
6	*Eugenol*	7.463	42.06	1.34	36.09
7	*Neryl acetate*	8.292	0.68		0.12
8	*Lavandulol*	10.998			0.84
9	*Caryophyllene oxide*	11.223	3.50	5.14	3.02
10	*Cardinol*	14.476	0.80		0.62
11	*Elemol*	17.798		11.29	
12	*γ – cadinene*	15.291		3.36	
13	*Spathulenol*	16.548	2.78	5.78	
14	*α - cadinol*	18.416	0.56	0.4	0.33
15	*Oxalic acid*	20.299	2.07		2.10

CONCLUSIONS

The present study gives a detailed overview of the morphological, biological, economical and biochemical characteristics of three basil cultivars. It was concluded that among cultivars there are differences in the chemical composition which affects in the scope of their use. The most completed in chemical composition are Wide leave leaves (autochthonous) and Narrow leave cultivars, and the fewer ingredients was shown to the Purple basil cultivar.

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