Essential Oil Composition of *Ocimum basilicum* L. and *Ocimum minimum* L. in Turkey

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Abstract

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The constituents of essential oils isolated by hydrodistillation of the overground parts of *Ocimum basilicum* L. and *Ocimum minimum* L. from Turkey were examined by GC-MS. A total of 49 and 41 components, respectively, were identified accounting for 88.1% and 74.4% of the oils of *O. basilicum* and *O. minimum*, respectively. The oil of *O. basilicum* contained, as main components, methyl eugenol (78.02%), α-cubebene (6.17%), nerol (0.83%) and ε-muurolene (0.74%). Major compounds in the volatile oil of *O. minimum* were geranyl acetate (69.48%), terpinen-4-ol (2.35%) and octan-3-yl-acetate (0.72%). The essential oil of *O. basilicum* was characterised by its high content of methyl eugenol (78.02%), whereas the most important essential oil constituent of *O. minimum* was geranyl acetate (69.48%).

Keywords: *O. basilicum* L.; *O. minimum* L.; *Lamiaceae*; essential oil

Basil (*Ocimum* spp.), belonging to the *Lamiaceae* family, is a pleasent by smelling perennial shrub which grows in several regions all over the world (AKGÜL 1993; BARIAUX *et al*. 1992). 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 flavour of the condiments. Many species of aromatic plants belonging to the *Lamiaceae* family grow wild in the Mediterranean basin (AKGÜL 1989; MAROTTI *et al*. 1996; SANDA *et al*. 1998; MARTINS *et al*. 1999).

There are usually considerable variations in the contents of the major components within this species. In a study of essential oils of different geographical origins, LAWRENCE (1988) found that the main constituents of the essential oil of basil are produced by two different biochemical pathways, the phenylpropanoids (methyl chavicol, eugenol, methyleugenol and methyl cinnamate) by the shikimic acid pathway, and the terpenes (linalool and geraniol) by the mevalonic acid pathway.

Sweet basil is a popular culinary herb and a source of essential oils extracted by steam distillation from the leaves and the flowering tops which are used to flavour foods, in dental and oral products, and in fragrances (GUENTHER 1952; HEATH 1981; AKGÜL 1989; SIMON *et al*. 1990; LACHOWICZ *et al*. 1996; MACHALE *et al*. 1997). There are many types, some large and some small, with a range of leaf colours from green to purple up to variated. Basil is native to India but is grown commercially all over the Mediterranean region and in California (HEATH 1981).

Basil is a condimental plant cultivated in some parts of Turkey, and used frequently in soups, desserts, pickles, pizza, spagetti sauce, egg, cheese dishes, tomate juice, dressings, confectionery, salads, meat products etc. as a flavouring agent. Also, basil is well known as a plant of a folk medicinal value and as such is accepted officially in a number of countries (HEATH 1981; LAWRENCE 1985). The leaves of basil are also used in folk medicine as tonic and vermifuge. Also, basil tea taken hot is good for treating nausea, flatulance and dysentery (BAYTOP 1984). Basil is used in pharmacy for diuretic and stimulating properties, in perfumes and cosmetics for its smell; in fact, it is a part of many fragrance compositions (BARIAUX *et al*. 1992; KHATRI *et al*. 1995). Its oil has been found to be beneficial for the alleviation of mental fatigue, colds, spasms, rhinitis, and as a first aid treatment for wasp stings and snake bites. The essential oil has antifungal, physicochemical and insect-repelling activity (LAHARIYA & RAO 1979; DUBE *et al*. 1989; ÖZCAN 1998; MARTINS *et al.* 1999). It is also regarded as highly antiseptic and has been applied in boths to prevent postpartum infections. One can inhale the vapours of the infusion of the leaves of *O. minimum* or take a bath to improve the general conditions and to ameliorate the respiratory function (MARTINS *et al*. 1999).

During the past few years there has been a marked increase in the interest shown in the herbal spices. One of the most popular of the spices is basil which is used to relish many kinds of foods (MAROTTI *et al.* 1996; HASEGAWA *et al*. 1997; RAVID *et al*. 1997). Some studies on the composition of the essential oil of basil have been carried out and the results have been published (RIAZ *et al*. 1994; KHATRI *et al*. 1995; LACHOWICZ *et al.* 1996; PINO *et al*. 1996; VENSKUTANIS *et al*. 1996; RAVID *et al.* 1997; HASEGAWA *et al.* 1997; SANDA *et al*. 1998; YUSUF *et al*. 1998; MARTINS *et al.* 1999; KEITA *et al*. 2000; MONDELLO *et al*. 2002). The essential oil is a liquid with lightly yellowish colour and a characteristic smell. The yield of essential oil from different plant parts varies between 0.15–1.59%, and it depends also on the seasonal factor and locality. Previously, as the characteristic compounds of basil essential oil linalool, methyl chavicol, eugenol, estragol, thymol and *p*-cymen were found (AKGÜL 1989; KHATRI *et al*. 1995; PINO *et al*. 1996; MARTINS *et al.* 1999; KEITA *et al*. 2000). However, only limited studies were conducted so far on the Turkish plant and volatile oil (AKGÜL 1989; ÖZEK *et al*. 1995). Therefore, in this study, we report on the chemical composition of the essential oils obtained from the air-dried parts of *Ocimum basilicum* and *O. minimum* plants cultivated in Turkey.

MATERIAL AND METHODS

Plant materials. Overground parts of *Ocimum basilicum* and *Ocimum minimum* were collected at the flowering stage in Içel (Ovacik-Gülnar) in August 2001. Plants were identified and authenticated by a plant taxonomist. Voucher specimens were kept at the Herbarium of the Department of Food Engineering with numbers OM1 and OB1.

Recovery of the essential oil. Dried overground parts of the plants (about 100 g) were cut into small pieces and subjected to hydrodistillation for 3 h using a Clevenger-type apparatus; the oils obtained were dried over anhydrous sodium sulphate. Essential oil yields of the air-dried overground parts of *Ocimum basilicum* and *Ocimum minimum* as obtained by hydrodistillation were, respectively, 1.25% and 1.71%.

Identification of components. For the identification of the components, analytical gas chromatography (GC) was performed using DELSI 121 C apparatus fitted with a flame ionization detector and a CP WAX 51 fused silica column (25 m × 0.25 mm i.d., 0.25 µm film thicknes). Temperature was kept at 50°C for 5 min and programmed to reach 220°C at the rate of 3°C per min. A CP W AX 51fused silica WCOT column (60 m × 0.25 mm i.d., 0.25 µm) for GC/MS was used with helium as carrier gas. For GC/MS, a CP-WAX 52 fused silica CB column (50 m × 0.3 mm; 0.25 µm film thicknes) was used with helium as carrier gas and coupled to a HP mass spectrometer: ionization energy 70 eV. Temperature programming was from 50–240°C at the rate of 3°C/min. The samples were injected at the injector temperature of 240°C. The components were identified by comparing linear Kovats indices (KI), their retention times (RT) and mass spectra with those obtained from the authentic samples and/or the MS library.

RESULTS AND DISCUSSION

Chemical compositions of the essential oils of *Ocimum basilicum* L. and *Ocimum minimum* L. are given in Table 1 in the order of the retention times of the constituents.

Fourty-nine constituents were identified in *O. basilicum*, representing 88.1% of the oil (Table 1). Methyl eugenol (78.02%), α-cubebene (6.17%), nerol (0.83%), α-muurolene (0.74%), 3,7-dimethyloct-1,5-dien-3,7-diol (0.33%) and β-cubebene (0.30%) were found as the major compounds. The essential oil of *O. minimum*, representing 74.4% of the oil, was characterised by the presence of geranyl acetate (69.48%), terpinen-4-ol (2.35%), octan-3-yl-acetate (0.72%), *n*-octanol (0.36%), chavicol (0.22%) and eugenol (0.13%).

The essential oil from *O. basilicum* contained α-pinene, sabinene, β-pinene, myrcene, limonene and (Z)- β-ocimene as the most important monoterpenes hydrocarbons. Among the monoterpenic hydrocarbons in *O. minimum* oil, α-thujene, α-pinene, sabinene, β-pinene, myrcene, α-terpinene and limonene were the most important. The contents of monoterpenic hydrocarbons were found to be low in both oils. Also, the amounts of oxygenated compounds such as 1,8-cineole, octen-3-ol, linalool, terpinen-4-ol (except for *O. minimum*), α-terpineol and nerol in both samples were found to be low.

The oil of *Ocimum* spp. was the subject of former studies (AKGÜL 1989; BARITAUX *et al.* 1992; RAVID *et al.* 1997; MARTINS *et al.* 1999; KEITA *et al*. 2000). It was previously reported (KEITA *et al*. 2000) that the oil of *O. basilicum* contained linalool (69%), eugenol (10%), (E)-α-bergamotene (3%) and thymol (2%). Linalool (45.7%), eugenol (13.4%), methyl eugenol (9.57%) and fenchyl alcohol (3.64%) were reported to be the main components of the previously analysed materials (AKGÜL 1989). KHATRI *et al*. (1995) found methyl chavicol (87.3%), linalool (5.4%), methyl eugenol (1.5%), β-caryophyllene (2.4%), α-pinene (1.0%), β-pinene (0.8%), limonene (0.5%) and camphene (02%). MAROTTI *et al*. (1996) reported the presence of

Table 1. Chemical composition of *Ocimum basilicum* L. oil

No.	RT	KI	Compound	Concentration (%)
1	8.75	928	α-pinene	0.002
2	9.92	960	benzaldehyde	0.002
3	10.24	969	sabinene	0.003
4	10.40	973	β-pinene	0.002
5	10.90	987	myrcene	0.006
6	11.49	1 003	cis-hex-3-enyl acetate	0.005
7	12.15	1 022	*p*-cymene	0.005
8	12.29	1 027	limonene	0.009
9	12.45	1 031	eucalyptol	0.001
10	12.93	1 045	*cis*-beta-ocimene	0.007
11	13.77	1 070	*cis*-linalool oxide	0.002
12	14.31	1 085	*trans*-linalool oxide	0.001
13	15.45	1 120	linalool	0.003
14	15.85	1 133	neo-allo-ocimene	0.002
15	16.16	1 143	*trans*-myroxide	0.003
16	16.29	1 147	menth-2-en-1-ol	0.001
17	16.86	1 165	pinocarvone	0.002
18	17.40	1 182	terpinen-4-ol	0.007
19	17.68	1 191	3,7-dimethyloct-1,5-dien-3,7-diol	0.327
20	17.87	1 197	α-terpineol	0.003
21	18.22	1 210	*n*-octyl acetate	0.021
22	18.45	1 217	endo-fenchyl acetate	0.036
23	18.67	1 225	nerol	0.825
24	19.04	1 238	neral	0.009
25	19.46	1 252	geraniol	0.259
26	19.89	1 267	geranial	0.010
27	20.88	1 301	carvacrol	0.028
28	21.67	1 330	bicycloelemene	0.012
29	21.85	1 337	exo-2-hydroxycineole acetate	0.048
30	22.07	1 345	α-cubebene	6.170
31	22.61	1 365	3,7-dimethylocta-1,7-dien-3,6-diol	0.025
32	22.92	1 377	geranyl acetate	0.088
33	23.01	1 380	α-ylangene	0.016
34	23.07	1 382	β-bourbonene	0.042
35	23.23	1 388	β-elemene	0.241
36	23.35	1 392	β-cubebene	0.297
37	23.48	1 397	methyl eugenol	78.016
38	24.02	1 419	β-caryophyllene	0.030
39	24.27	1 429	β-copaene	0.087
40	24.32	1 431	trans-alpha-bergamotene	0.021
41	24.40	1 433	α-guaiene	0.198
42	24.68	1 444	cadina-3,5-diene	0.147
43	24.82	1 450	epsilon-muurolene	0.736
44	24.94	1 455	α-humulene	0.117
45	25.10	1 461	*cis*-muurola-4(14),5-diene	0.101
46	25.20	1 465	β-acoradiene	0.071
47	25.42	1 474	α-acoradiene	0.052
48	25.59	1 481	germacrene d	0.031
49	25.94	1 494	bicylogermacrene	0.006

Table 2. Chemical composition of *Ocimum minimum* L. oil

No.	RT	KI	Compound	Concentration (%)
1	8.50	922	α-thujene	0.002
2	8.77	929	α-pinene	0.004
3	9.97	961	benzaldehyde	0.007
4	10.27	970	sabinene	0.010
5	10.42	974	β-pinene	0.003
6	10.66	980	octen-3-0l	0.004
7	10.92	988	myrcene	0.013
8	11.52	1 004	cis-3-hexenyl acetate	0.002
9	11.87	1 014	α-terpinene	0.003
10	12.29	1 027	limonene	0.002
11	12.36	1 029	β-phellandrene	0.003
12	12.44	1 031	eucalyptol	0.010
13	12.94	1 045	trans-β-ocimene	0.006
14	13.33	1 057	gamma-terpinene	0.13
15	13.78	1 070	cis-linalool oxide	0.010
16	14.32	1 086	trans-linalool oxide	0.030
17	14.60	1 094	*n*-octanol	0.355
18	15.55	1 123	linalool	0.012
19	15.69	1 128	octan-3-yl acetate	0.720
20	15.92	1 136	neo-allo-ocimene	0.013
21	15.97	1 137	cyclopentanal-1,2-dimethyl-3(1-methylethenyl)	0.055
22	16.31	1 147	cis-menth-2-en-1-ol	0.033
23	16.44	1 152	plinol	0.022
24	17.43	1 183	terpinen-4-ol	2.352
25	17.73	1 193	methyl calicylate	0.019
26	17.88	1 197	α-terpineol	0.022
27	18.26	1 211	*n*-octyl acetate	0.007
28	18.69	1 226	nerol	0.034
29	18.82	1 230	cis-3-hexenyl valerate	0.027
30	19.36	1 249	linalyl acetate	0.194
31	19.43	1 251	geraniol	0.070
32	19.66	1 259	chavicol	0.224
33	20.31	1 281	geranyl acetate	69.48
34	20.37	1 283	bornyl acetate	0.095
35	20.68	1 294	myrtenyl formate	0.03
36	20.90	1 302	carvacrol	0.043
37	21.69	1 331	β-cycloelemene	0.032
38	21.86	1 337	exo-2-hydroxycineole acetate	0.018
39	22.09	1 346	α-cubebene	0.120
40	22.37	1 356	eugenol	0.126
41	22.89	1 376	α-copaene	0.028

linalool, methyl chavicol and eugenol as main components of *O. basilicum*. In another study, the major compounds reported were linalool and methyl chavicol (LACHOWICZ *et al.* 1996).

The results published on the chemical composition of *O. minimum* oil reveal that linalool (52.7%) represents the most important compound in the genus followed by eugenol (9.1%) and bornyl acetate (1.9%). Our results were generally different, according to literature findings, as concerns the major compounds. The observed differences may be probably due to different environmental and genetic factors, different chemotypes and the nutritional status of the plants as well as other factors that can influence the oil composition. These results show that *O. basilicum* and *O. minimum* are remarkably variable species. Actually, the high quantities of methyl eugenol and geranyl acetate, respectively, make them a most interesting species from the economic point of view. LAWRENCE (1988) proposed several chemotypes based on the composition of the essential oils.

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Souhrn

ÖZCAN M., CHALCHAT J.-C. (2002): **Složení silic z** *Ocimum basilicum* L**. a** *Ocimum minimum* L. **tureckého původu**. Czech J. Food Sci., **20**: 223–228.

Složky silic izolovaných hydrodestilací z nadzemních částí rostlin *Ocimum basilicum* L. a *Ocimum minimum* L. původem z Turecka byly analyzovány plynovou chromatografií (GC-MS). Celkový počet identifikovaných složek byl 49 (*O. basilicum*) a 41 (*O. minimum*); ty tvořily 88,1 % (*O. basilicum*) a 74,4 % (*O. minimum*) z celkového obsahu silic. Hlavními složkami silice z *O. basilicum* byly methyleugenol (78,02 %), α-cubeben (6,17 %), nerol (0,83 %), a ε-muurolen (0,74 %). V silici *O. minimum* byly nejvíce zastoupeny geranyl acetát (69,48 %), terpinen-4-ol (2,35 %), a oktan-3-yl-acetát (0,72 %). Pro silici z *O. basilicum* byl tedy charakteristický vysoký obsah methyleugenolu (78,02 %), zatímco nejvýznamnější složkou silice z *O. minimum* byl geranyl acetát (69,48 %).

Klíčová slova: *O. basilicum* L.; *O. minimum* L.; *Lamiaceae*; silice

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