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Comparative Study of Constituents of Essential Oils of *Ocimum basilicum* L. Cultivated in the Mongolian Gobi

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Abstract

The essential oils of the herb *Ocimum basilicum* L., cultivated in the Mongolian Gobi, have been examined. Oils were isolated by hydro-distillation and analyzed by GC-MS. The principle components of **Common Basil** were methyl chavicol (52.1 %), linalool (23.9 %). In the oils of the different varieties of Basil were the following compounds found: **Sweet Basil**: linalool (24.5–27.4 %), methyl chavicol (19.8–20.0 %), bergamotene (10.0 %), 1.8-cineole (8.5 %); **Purple Basil**: linalool (52.8 %), 1.8-cineole (8.7 %); **Cinnamon Basil**: methyl chavicol (60.4 %), 1.8-cine-ole (6.3 %), linalool (3.3 %) and cadinol (3.2 %); **Italian large leaf Basil**: linalool (33.4 %), (Z)-methyl cinnamate (16.6 %), 1.8-cineole (8.7 %), α-cubebene (5.7 %) and β-bergamotene (5.8 %); **Compact Basil**: linalool (33.9 %), β-bergamotene (17.2 %), (Z)-methyl cinnamate (7.6 %), T-cadinol (7.3 %) and 1.8-cineole (5.7 %); and **Lemon Basil**: geranial (24.7 %), neral (19.6 %), linalool (8.1 %), T-cadinol (11.7 %), β-caryophyllene (9.9 %), 1.8-cineole (8.1 %) and α-cubebene (6.6 %);

Key words: *Ocimum basilicum* L. (Lamiaceae), essential oil, methyl chavicol, linalool, 1.8-cineole, GC and GC-MS

Introduction

Ocimum basilicum L. is cultivated commercially in many countries (e.g. India, France, Morocco, Italy), mainly for its essential oil, which is used extensively in the pharmaceutical and cosmetics industry (WULF & MALEEVA 1969).

The medicinal properties of the plant are highlighted by its use as a carminative and stimulant (NADKARNI 1954). The seeds are said to have demulcent and diuretic properties, and the oils' pleasant odor is responsible for its use in expensive perfumes, liqueurs and seasonings (KORSHIKOV et al. 1985, GEIDEMAN et al. 1962).

Basil is also commonly cultivated in many tropical countries, such as South America, Madagascar, Sri Lanka, Cambodia, Malaysia, Indonesia, the Philippines etc. (GILDEMEISTER & HOFFMANN 1961, GÜNTHER 1949). *Ocimum basilicum* is an introduced species to Fiji and is recognized as a useful therapeutic agent among its peoples (BROPHY 1986). The aromatic leaves are used fresh or dried as a flavoring agent for food and confectionery products and possess antimicrobial activity (OMIDBAIGI et al. 2003, TRUEYN & CHAN 1998).

A number of different chemotypes of Basil exist. Varieties rich in methyl chavicol, linalool, 1.8-cineol and some sesquiterpenoids have been established (LAWRENCE et al. 1971, LAWRENCE 1988, 1992, 1998; OEZEK et al. 1995, PINO & RONEAL 1994, SHATAR 2000, SHATAR & ALTANTSETSEG 2000). Studies dealing with the chemical composition of essential oils of *Ocimum basilicum* from different geographical courses revealed several chemotypes (KORSHIKOV et al. 1985, LAVRENOVA et al. 1999). The main chemotype from Islands and Madagascar contains methyl chavicol alongside with small amounts of 1.8-cineole, linalool and eugenol (GILDEMEISTER & HOFFMANN 1961, GÜNTHER 1949). Another chemotype, characteristic of southern Europe and Egypt, produces an essential oil with high levels of linalool (LAWRENCE et al. 1971, SHATAR 2000). The aim of the present paper was to give first data on the chemical composition of the essential oils of some *Ocimum basilicum* varieties cultivated in the Mongolian Gobi.

Methods

Plant material: Seed of various *Ocimum basilicum* L. accessions (LAWRENCE et al.1971, LAWRENCE 1988, 1992, 1998; OMIDBAIGI et al. 2003, SHATAR 2000, SHATAR & ALTANTSETSEG 2000, SHATAR et al. 2007, FERNANDO & TATEO 1989, PINO & RONEAL 1994) provided from USA, were used in this study. Most of the plant material was collected in August and September from experimental plots in the Mongolian Gobi.

Essential oils isolation procedure: The dried aerial parts of the plants were subjected to a Clevenger-type hydro distillation apparatus (ADAMS 1991) for 3 hours. The sampled yellow oil was dried over anhydrous sodium sulfate and stored under nitrogen in sealed vials in a cool place at 4° C.

Gas chromatographic-mass spectral analysis: The leaf and flower essential oil of *Ocimum basilicum* was subjected to gas chromatographic-mass spectral analysis using an Agilent 6890 GC with Agilent 5973 mass selective detector fused silica capillary column (HP-5 ms, 30 m x 0.25 mm), helium carrier gas, 1ml/min flow rate; injection temperature 200° C, oven temperature program: 40° C initial temperature, hold for 10 min; increased at 3° C/min to 200° C; increased 20° C/min to 220° C and inter face temperature 280° C; EIMS, electron energy, 70 e. V.

The sample was dissolved in $CHCl_3$ to give a 1 % w/v solution; 1 ml injections using a split less injection technique were used. Identification of oil components was achieved based on their retention indices, and by comparison of their mass spectral fragmentation patterns with those reported in the literature (ADAMS 1995).

Results and discussion

Some varieties of *Ocimum basilicum* are successfully cultivated at irrigated sites in the provinces Middle and Eastern Gobi in Mongolia, where June-September are sunny with warm days reaching up to 20° to 30° C. The differences observed in the chemical composition of essential oils of the seven varieties of *Ocimum basilicum* cultivated in the Gobi could be attributed to their genetic potential, ecological conditions and climatic variations (see table 1).

Basil oils are obtained by distillation of the leaves and flowers of *Ocimum basilicum* and have aromas characteristic of the particular varieties used. The oils are classified in the trade into three broad types according to their composition and main end-use: perfumery-cosmetic, medicinal and food industrials.

Of these, the most important in terms of volume of production and trade is the perfumery-cosmetic type, characterized by high linalool content in the oil. The medicinal type is, characterized by a high 1.8-cineole concentration, and the food industrial type is characterized by high methylchavicol content in the oils.

Those varieties of *Ocimum basilicum* currently exploited in the countries where they are utilized are listed below:

- For perfumery-cosmetic industry: *Ocimum basilicum* varieties Basil purple, Basil compact and Basil Italian large leaf;
- For food industry: *Ocimum basilicum* varieties Basil common, Basil cinnamon, Basil sweet and Basil lemon;
- In medicinal industry: other varieties of *Ocimum basilicum* including variety Basil Italian large leaf among others.

Natural essential oils of *Ocimum basilicum* are in increasing demand from Mongolian manufacturers of food, cosmetics, pharmaceuticals and nutriceuticals. The most interesting chemical components (neral, geranial, linalool) of essential oils of *Ocimum basilicum* L. are found in the varieties Basil purple, Basil compact and Basil lemon, which are extensively used in the Mongolian food and perfumery-cosmetic industry. Thus, these aromatic components were imported to a very large extent.

Table 1: Chemotypically characteristic major components of essential oils from varieties of *Ocimum basilicum* cultivated in the Mongolian Gobi (characteristic components in bold)

Compounds	**Variety of *Ocimum basilicum* L.**						
	Basil common	**Basil sweet**	**Basil purple**	**Basil cinnamon**	**Basil Italian large leaf**	**Basil compact**	**Basil lemon**
α-pinene	0.20	0.22	0.32	0.38	0.47	0.49	0.19
cabinene	0.92	0.28	0.41	-	-	-	-
β-pinene	0.13	0.50	0.74	0.52	0.72	0.40	0.41
1.8-cineole	0.8	**8.5**	**8.7**	**6.3**	**8.7**	**5.7**	0.15
linalool	**23.9**	**27.4**	**52.8**	3.3	**33.4**	**33.9**	**8.1**
methyl chavicol	**52.1**	**19.8**	0.5	**60.4**	0.2	-	-
nerol	-	-	-	-	-	-	3.2
neral	-	-	-	-	-	-	**19.6**
geranial	-	-	-	-	-	-	**24.7**
(Z)-methylcinnamate	-	-	-	-	**16.6**	**7.6**	-
α-cubebene	-	-	-	3.7	**5.7**	0.7	**6.6**
caryophyllene	-	-	-	-	0.7	0.3	**9.9**
β-bergamotene	1.1	**10.0**	1.0	0.4	**5.8**	**17.2**	3.6
T-cadinene	-	-	-	-	3.9	3.5	**11.7**
E-nerolidol	1.4	3.2	0.3	-	-	-	-
T-cadinol	4.2	**5.7**	3.2	3.8	**8.3**	**7.3**	-
monoterpene hydrocarbons (%)	**1.25**	**1.0**	**1.47**	**0.9**	**1.19**	**0.89**	**0.6**
oxygenated mono-terpenoids (%)	**76.8**	**55.7**	**62.0**	**70.0**	**58.5**	**47.2**	**58.8**
sesquiterpene hydrocarbons (%)	**1.1**	**10.0**	**1.0**	**4.1**	**16.1**	**21.7**	**31.8**
oxygenated ses-quiterpenoids (%)	**5.6**	**8.9**	**3.5**	**3.8**	**8.3**	**7.3**	-
Total	**84.75**	**75.6**	**67.97**	**78.8**	**84.09**	**77.09**	**91.2**

The chemotypes of the main constituents of essential oils of *Ocimum basilicum* found in varieties cultivated in the Mongolian Gobi were:

- Chemotype of linalool: Basil **purple** (52.8 %), Basil **Italian large leaf**, Basil **compact** (33.4 –33.9 %), Basil **common** (23.9–27.4 %);
- Chemotype of methyl chavicol: Basil **cinnamon** (60.4 %), Basil **common** (52.1 %);
- Chemotype of citral: Basil **lemon** (geranial 24.7 %, neral 19.6 %).

Ocimum basilicum variety *Basil* **common** from Mongolia yielded compounds corresponding to 0.6-0.75 % (w/w) on a dry matter base. Oxygen containing monoterpenes dominated quantitatively (81.6 %). The main constituents were methyl chavicol (52.1 %), linalool (23.9 %), camphor (1.7%), terpinen-4-ol and α-terpineol (1.2 %), methyl eugenol (1.1 %), 1.8-cineole (0.8 %).

The composition of essential oils of **Basil common** from Turkey is very different according to Omidbaigi et al (OMIDBAIGI et al. 2003) with large amounts of methylcinnamate (12.7 %), 1.8-cineole (7.1 %), T-cadinol (7.1 %) and germacren-D (3.6 %). The essential oil composition of Mongolian Basil common is more similar to that reported by FERNANDO & TATEO (1989) for Italy and PINO & RONEAL (1994) for Cuba.

Table 2: Comparative data on composition of the essential oils of *Ocimum basilicum* varieties cultivated in Mongolian Gobi and other countries

Compounds	Common Basil				Sweet Basil		
	Italy[1]	Cuba[2]	Turkey[3]	Mongolia[4]	Mongolia[5]	Iran[3]	Fiji[6]
α-pinene	0.20	0.72	0.46	0.20	0.22	0.10	tr
sabinene	0.25	0.31	0.35	0.92	0.28	0.44	tr
β-pinene	0.24	0.82	0.99	0.13	0.50	0.71	tr
myrcene	0.20	1.80	0.26	1.20	0.43	2.85	tr
1.8-cineole	5.50	5.44	7.13	0.80	8.54	6.58	4.60
(E)-β-ocimene	-	2.18	0.02	0.60	0.33	1.97	tr
linalool	28.20	4.95	17.71	23.85	27.36	53.70	22.30
camphor	-	-	0.45	1.7	1.05	0.10	tr
terpin-4-ol	-	-	-	0.54	0.90	0.22	tr
terpineol	0.60	-	0.96	0.52	1.66	0.17	tr
methyl chavicol	30.00	66.75	-	52.06	19.77	6.26	tr
bornylacetate	-	-	0.42	0.84	1.22	0.78	tr
eugenol	2.50	0.57	2.67	0.16	-	3.14	3.20
methyleugenol	1.20	0.20	0.82	1.14	-	1.38	24.70
methylcinnamate	-	-	12.66	-	-	-	23.60
β-elemene	-	-	-	2.00	1.66	0.08	-
(Z)-α-bergamotene	-	2.96	-	1.12	10.00	4.60	-
α,γ-guaiene	-	-	4.26	-	0.85	-	-
α-humulene	-	0.64	1.18	0.50	0.84	0.27	-
germacrene-D	-	1.36	3.62	1.30	3.51	0.13	-
bicyclogermacrene	-	-	-	-	0.45	0.46	-
δ-guaiene	-	-	-	-	1.55	-	-
nerolidol	-	-	0.47	0.44	3.21	-	-
T-cadinol	-	-	7.14	4.42	5.72	-	-
β-eugenol	-	-	0.30	0.45	-	3.63	-

[1] FERNANDO & TATEO (1989), [2] PINO & RONEAL (1994), [3] OMIDBAIGI et al. (2003), [4] SHATAR & ALTANTSETSEG (2000), [5] SHATAR & ALTANTSETSEG (2007), [6] BROPHY & GOGIA (1986)

The essential oils of Mongolian *Ocimum basilicum* variety **Basil sweet** contained 6 compounds corresponding to a yield of 0.45 – 0.60 % (w/w) based on dry material. Oxygen containing monoterpenes dominated quantitatively (60.6 %). The main constituents were linalool (27.4 %), methyl chavicol (19.8%), 1.8-cineole (8.5%), camphor, terpinen-4-ol and α-terpineol (4.9 %). In addition (Z)-α-bergamotene (10.0 %), T-cadinol (4.4 %), elemene (1.3 %), γ-quaiene, γ-humulene (1.7 %) and nerolidol (0.4 %) were found. This essential oil composition is similar to values reported by other authors from the Iran (OMIDBAIGI et al. 2003) and Fiji (BROPHY & GOGIA 1986). In the sample from Iran we did, however, notice a higher amount of linalool (53.7 %), 1.8-cineole (6.6 %), methyl chavicol (6.3 %), (Z)-α-bergamotene (4.6 %) and β-eugenol (3.6 %).

Conclusion

Differences in chemical composition were observed among seven varieties of *Ocimum basilicum* cultivated in the Outer Mongolian Gobi. Compared to samples from other regions, Mongolian specimens were also different which could be attributed to their genetic potential, ecological conditions and climatic variations.

These results suggest new possibilities for usage of essential oils obtained from various *Ocimum basilicum* varieties cultivated in the Mongolian Gobi, not only in the food and cosmetics industry, but also as natural pharmaceutical remedy.

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