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Studies on the essential oil bearing plants of Bangladesh. Part VI. Composition of the oil of *Ocimum gratissimum* L.†

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ABSTRACT: The composition of the essential oil of *Ocimum gratissimum* L. obtained from plants originating from Bangladesh and from plants introduced into Bangladesh from India is reported. The oil obtained from plants native of Bangladesh can be classified as thymol-type according to its thymol content (58.2%), while the oil obtained from plants introduced from India can be classified as eugenol/ocimene type according to its content of eugenol (66.5%) and ocimenes (18.9%). © 1998 John Wiley & Sons, Ltd.

KEY WORDS: *Ocimum gratissimum* L.; essential oil composition; chemotypes; gas chromatography; GC–MS; thymol; eugenol; ocimene

Introduction

Ocimum gratissimum L. (shrubby basil) is a tall, much-branched perennial shrub, 1–2.5 m high, distributed in the tropical areas of Africa, America and Asia. In the Indian subcontinent it is found in the peninsular India (West Bengal and Assam) and in Bangladesh.[2]

The oils distilled from *O. gratissimum* are characterized, generally, by their high phenol content, consisting mainly of eugenol[3–23] or thymol.[24–26] Other chemotypes are also reported: a linalol type;[14] a geraniol type;[27] a methyl cinnamate and a eugenol/sesquiterpene type;[28] an ocimene type, an ocimene/methyl isoeugenol type and a eugenol/ocimene type;[29] an ethyl cinnamate type,[30] a citral type;[31] a sesquiterpene type;[32] a eugenol/methyl eugenol type.[33] In the eugenol type, the eugenol content ranges from 18%[6] to 90%[8]; while in the thymol type the thymol content ranges from 19%[25] to 48%[24].

In this paper the composition of the essential oil of *O. gratissimum* isolated from the plants originating from Bangladesh and identified by Khan and Khanam[2] and the oil from the plants of *O. gratissimum* var. *clocimum* evolved in India by Sobti[5] and introduced into Bangladesh in 1986 is reported.

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Experimental

The leaves and the inflorescences were collected from the plants grown in the campus of Bangladesh Council of Scientific and Industrial Research (BCSIR) Laboratories, Chittagong during September 1995 (*O. gratissimum* var. *clocimum*) and May 1996 (Bangladeshian *O. gratissimum*). The oils were isolated from the fresh leaves and inflorescences by hydrodistillation carried out for 2 hours in a modified Clevenger-type apparatus.

Voucher samples of *O. gratissimum* originating from Bangladesh are retained in Bangladesh National Herbarium, Dhaka; while voucher samples of *O. gratissimum* evolved in India are retained in the Herbarium of the Regional Research Laboratories, CSIR, Jammu-Tawi. Both are also retained in the Herbarium of BCSIR Laboratories, Chittagong.

GC Analysis

We used a Fisons chromatograph 5160 Mega Series equipped with a Shimadzu data processor C-R 3A; an SE-52 fused silica column (25 m × 0.32 mm, film thickness 0.40–0.45 μm, Mega, Legnano, Italy); column temperature, 40°C (6 min) to 240°C at 3.0°C/min; injector temperature, 250°C; detector temperature, 280°C; injection mode, split; split ratio, 1:50; volume

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Table 1. Relative percentage as single components and as classes of substances for the oil of *Ocimum gratissimum* L. native to Bangladesh (A) and of *Ocimum gratissimum* L. var. *clocimum* introduced into Bangladesh from India (B)

Compound	Area (%)		Linear retention indices on DB-5	Identification methods			
	A	B					
(*Z*)-Hex-3-en-1-ol	<0.1		nd	a		c	d
α-Thujene	2.0		924	a	b	c	d
α-Pinene	0.8		932	a	b	c	
Camphene	0.1		948	a	b	c	d
Sabinene	0.4		971	a	b	c	d
Oct-1-en-3-ol		0.1	977	a			
β-Pinene	0.5		977	a	b	c	d
Octan-3-one		<0.1	985	a			
Myrcene	2.6	0.4	988	a	b	c	d
Octan-3-ol		0.1	996	a	b	c	d
(*E*)-Hex-3-enol acetate		<0.1	1004	a	b		d
α-Phellandrene	0.3		1007	a	b	c	d
δ-3-Carene	0.1		1009	a	b	c	d
α-Terpinene	1.2		1016	a	b		
p-Cymene	7.7		1024	a	b	c	d
Limonene	1.1		1028	a	b	c	d
β-Phellandrene	0.1		1029	a	b		d
1,8-Cineole			1031	a	b		d
(*Z*)-β-Ocimene	0.2	18.1	1033	a	b	c	d
(*E*)-β-Ocimene	0.2	0.8	1043	a	b	c	d
γ-Terpinene	12.3		1058	a	b	c	d
cis-Sabinene hydrate	0.3		1068	a	b		
Terpinolene	1.5		1084	a		c	
p-Cymenene	<0.1		1089	a	b		d
Linalol	0.3	0.6	1099	a	b	c	d
1,3,8-*p*-Menthatriene	<0.1		1111	a			d
α-Thujone	0.1		1117	a	b		d
allo-Ocimene		0.4	1127	a	b	c	d
cis-*p*-Menth-2-en-1-ol	<0.1		1127	a	b		
(*E*)-Myroxide		0.1	1138	a			
Borneol	0.2		1171	a			
p-Menth-1,5-dien-8-ol		0.1	1170	a			d
Terpinen-4-ol	1.4		1179	a	b	c	d
p-Cymen-8-ol	0.4		1188	a	b		d
trans-*p*-Mentha-2,8-dien-1-ol		0.7	1201				d
Thymol methyl ether	0.2		1284	a	b		
Thymol	58.2		1297	a	b		d
Carvacrol	0.9		1302	a	b		d
α-Cubebene		<0.1	1344	a	b		
Eugenol	0.1	66.5	1348	a	b		d
α-Copaene	<0.1	0.8	1375	a	b	c	d
β-Bourbonene		0.2	1382	a	b	c	d
β-Cubebene		0.4	1387	a	b	c	
β-Elemene	0.1	0.1	1388	a	b	c	d
Isocaryophyllene		<0.1	1395	a			
β-Caryophyllene	0.6	2.1	1416	a	b	c	d
β-Gurujene		0.1	1426	a			
trans-α-Bergamotene	<0.1		1430	a	b	c	
α-Humulene	0.1	0.2	1451	a	b	c	
Germacrene-D	<0.1	2.9	1478	a	b	c	d
β-Selinene	1.1		1485	a	b		d
α-Selinene	0.7		1491	a	b	c	d
(*E*,*E*)-α-Farnesene		0.1	1503	a	b	c	d
7-*epi*-α-Selinene	0.2		1514	a			
δ-Cadinene		0.3	1515	a	b	c	d
Spathulenol		0.2	1572	a	b	c	d
Caryophyllene oxide	0.5	0.2	1576	a	b	c	
Humulene epoxide II	0.1		1603	a			d
14-Hydroxy-9-*epi*-β-Caryophyllene		0.2	1663	a			
Isolongifolol	0.1		1716	a			
(*E*)-Conypheril alcohol		0.2	1727	a			d
Monoterpene hydrocarbons	30.9	19.7					
Sesquiterpene hydrocarbons	2.8	7.2					
Alcohols	2.8	2.0					
Esters		<0.1					
Phenols and derivatives	59.5	66.5					
Eters and oxides	0.6	0.3					
Ketones	0.1	<0.1					

a, Adam's library; b, Parfume library;[36] c, FFC bank, co-injection with authentic compounds; d, NIST library; nd, not determined.

injected, 1 μl of a solution 1/20 in pentane of the oil; carrier gas, He, 100 kPa.

GC–MS Analysis

We used a CE Instruments MD 800 equipped with Adams' library,[34] FFC bank,[35] Parfume library (CE Instruments)[36] and NIST library; DB-5 fused silica column (30 m × 0.25 mm, film thickness 0.25 μm, J & W, Folston, California, USA); column temperature, 60–240°C at 3°C/min, to 300°C at 30.0°C/min; injector temperature, 250°C; injection mode, split; split ratio, 1:20; volume injected, 1 μl of a solution 1/20 in pentane of the oil; carrier gas, He, 83 kPa; linear velocity, 40 cm/sec at 60°C; interface temperature, 250°C; source temperature, 200°C, EI^+ acquisition with mass range of 41–300 amu.

Results and Discussion

O. gratissimum native to Bangladesh yielded 0.75% (volume/fresh wt.) of essential oil. Table 1 shows the relative percentage as single components and as classes of substances for this oil. Forty-two components were identified that represent about 97% of the whole oil. The main component was thymol (58.2%), followed by γ-terpinene (12.3%) and *p*-cymene (7.7%). The total content of phenol compounds was 59.5%. Monoterpene hydrocarbons represents 30.9%, sesquiterpene hydrocarbons 2.8% and alcohols 2.8%. The oil also contained three oxides: 1,8-cineole, caryophyllene oxide and humulene oxide II, and small quantities of a ketone, α-thujone.

According to the thymol content, this oil could be classified as thymol-type oil, but it shows a thymol content higher than those reported in literature for *O. gratissimum* thymol-type oils.

Table 1 also shows the relative percentage as single components and as classes of substances for the oil of *O. gratissimum* var. *clocimum*, an Indian native introduced into Bangladesh. This yielded 0.72% of oil. Here 29 components were identified that represent about 96% of the whole oil. The main component was eugenol (66.5%), followed by (*Z*)-β-ocimene (18.1%). Among the other components only two sesquiterpene hydrocarbons, germacrene-D (2.9%) and β-caryophyllene (2.1%) occur at a percentage higher than 1%. According to the content of the main components, this oil could be classified as eugenol/ocimene type. Moreover, the sesquiterpene hydrocarbon fraction of the oil is qualitatively and quantitatively rich.

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