



Progress in Essential Oils

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Caraway Oil

Gosa et al. (1997) reported that Polish caraway oil normally contained limonene (45.6 percent) and carvone (49.3 percent) as major constituents.

Braun and Franz (2001) examined four samples of caraway oil that were available commercially in Germany. In these samples, the myrcene (0.19-93 percent), limonene (39.44-48.16 percent) and carvone (48.83-55.07 percent) contents varied. Although DAB standards in Germany state that the amount of (4R)-(-)-carvone should be less than 1.0 percent in genuine oil, the authors found that two of the oils possessed levels of (-)-carvone of 5.19 percent and 3.23 percent, respectively, indicating that these two commercial oils were adulterated.

Bailer et al. (2001) determined the oil yield and composition of selected major oil components from the seed oils of 11 cultivars of caraway available in Austria. The results of this study can be found in T-1.

Chowdhury (2002) analyzed an oil produced from dried caraway fruit (seed) obtained from the Kumaon region of Uttaranchal (India). The components identified in this oil were:

α -pinene (0.12 percent)
camphene (0.12 percent)
 β -pinene (0.11 percent)
sabinene (0.16 percent)
myrcene (0.12 percent)
 δ -3-carene (0.12 percent)
 α -terpinene (0.08 percent)
p-cymene (0.13 percent)
 β -phellandrene (0.20 percent)
isolimonene[†] (2.73 percent)
terpinolene (0.10 percent)
limonene oxide* (4.36 percent)
linalool (0.10 percent)
dihydrocarvone* (3.91 percent)
citronellyl acetate[†] (0.62 percent)
carvone (81.5 percent)
dihydrocarveol (0.21 percent)
carveol* (0.32 percent)
p-mentha-2,8-dien-1-ol (0.52 percent)
eugenol[†] (2.09 percent)

*correct isomer not identified; [†]incorrect identification

It is a major surprise that the author did not identify any limonene in this oil, as it is a major component of caraway oil. It would appear to this reviewer that the oil analyzed is not a genuine pure caraway oil.

A sample of caraway oil was the subject of analysis by Kubeczka and Formacek (2002) using a combination of capillary GC and ¹³C-NMR. The components identified in this oil were:

α -pinene (0.07 percent)
 β -pinene (0.01 percent)
sabinene (0.10 percent)
myrcene (0.46 percent)
limonene (53.85 percent)
 β -phellandrene (0.03 percent)
p-cymene (0.03 percent)
cis-limonene oxide (0.12 percent)
trans-limonene oxide (0.06 percent)
linalool (0.07 percent)
cis-dihydrocarvone (0.48 percent)
trans-dihydrocarvone (0.12 percent)
 α -terpineol (0.09 percent)
carvone (43.39 percent)
dihydrocarveol (0.10 percent)
isodihydrocarveol (0.12 percent)
neoisodihydrocarveol (0.40 percent)
trans-carveol (0.15 percent)
cis-carveol (0.08 percent)

Chemat et al. (2004) compared atmospheric soxhlet extraction (using hexane) and standard conditions with ultrasound extraction (also using hexane) of flaked caraway seed. They showed that carvone yield and

Cultivar	Oil yield (percent)	Component content (mg/g)						
		1	2	3	4	5	6	7
Kami	4.38 ^a	0.15	16.83	0.05	0.06	0.04	19.13	0.09
Konczewicki	4.39-4.81 ^b	0.16-0.19	19.51-22.15	0.04-0.07	0.04-0.10	0.03-0.14	16.36-19.91	0.13
Sylvia	3.85-4.13	0.15-0.17	14.51-19.71	0.05-0.07	0.05-0.11	0.05-0.19	16.77-17.53	0.07-0.12
Volhouden	4.76	0.18	19.02	0.05	0.04	0.04	18.25	0.08
Plewiski	4.45	0.15	21.45	0.08	0.13	0.18	17.62	0.15
Mühlviertler	5.04	0.19	22.93	0.08	0.12	0.14	18.68	0.16
Krawinkler	4.23	0.16	21.47	0.07	0.12	0.17	16.69	0.14
Israeli	2.90-3.34	0.08-0.15	13.58-14.21	0.12-0.13	0.09	0.32-0.35	10.45-14.11	0.06-0.07
Karzo	2.78-3.05	0.12-0.13	13.41-13.42	0.11-0.14	0.09-0.11	0.36-0.47	10.84-13.21	0.06-0.08
Milly la Foret	2.82-3.24	0.11-0.13	13.92-14.37	0.09-0.14	0.10	0.41-0.42	10.91-13.59	0.06-0.08
Szilás	2.86-3.19	0.10-0.15	13.37-13.84	0.12-0.14	0.09-0.11	0.35-0.41	11.49-13.43	0.06-0.07

components listed are: 1. myrcene; 2. limonene; 3. *trans*-dihydrocarvone; 4. *cis*-dihydrocarvone; 5. *cis*- and *trans*-carveol; 6. carvone; 7. perillaldehyde; ^a = single season; ^b = two seasons

extract quality were considerably better for ultrasound extraction rather than conventional soxhlet extraction.

A hydrodistilled oil of *Carum carvi* was screened against a range of bacteria by Iacobellis et al. (2005). The content of this oil was found to be as follows:

octanal (1.2 percent)
limonene (18.2 percent)
nonanal (0.3 percent)
linalool (0.3 percent)
cis-limonene oxide (< 0.1 percent)
trans-limonene oxide (0.1 percent)
(*Z*)-tagetone (0.2 percent)
dihydrocarveol (4.5 percent)
cis-dihydrocarvone (0.4 percent)
trans-dihydrocarvone (14.0 percent)
trans-carveol (0.1 percent)
cis-carveol (0.1 percent)
carvone (23.3 percent)
(*Z*)-2-decenal (0.4 percent)
(*E*)-2-decenal (0.2 percent)
cis-carvone oxide (0.3 percent)
(*E*)-anethole (3.3 percent)
carvacrol (6.7 percent)
β-caryophyllene (6.1 percent)
germacrene D (16.2 percent)
δ-cadinene (0.5 percent)
germacrene B (3.8 percent)

The origin of the caraway seeds used for oil production was not disclosed by the authors; however, it should be pointed out that the composition is somewhat unusual for a caraway seed (or fruit) oil. The oil analyzed is more like a comparative oil between caraway herb and caraway seed, even though it is a caraway seed oil.

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A.R. Chowdhury, *GC-MS studies on essential oil from Carum carvi L. raised in Kumaon*. J. Essent. Oil Bear. Plants, **5**, 158-161 (2002).

K-H. Kubeczka and V. Formacek, *Essential oils analysis by capillary gas chromatography and carbon -13 NMR spectroscopy*. 2nd Ed., 37-41, J. Wiley & Sons, NY (2002).

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N.S. Iacobellis, P. LoCantore, F. Capasso and F. Senatore, *Antibacterial activity of Cuminum cyminum L. and Carum carvi L. essential oils*. J. Agric. Food Chem., **53**, 57-61 (2005).

Litsea cubeba Oil

A fruit of *Litsea cubeba* produced in the laboratory in Thailand from locally grown fruit was found (Punyarajun and Nandhasri, 1981) to contain the following major constituents:

α-pinene (2.77 percent)
β-methyl-5-hepten-2-one (8.88 percent)
β-pinene (1.86 percent)
limonene (25.33 percent)
linalool (2.87 percent)
citronellal (2.32 percent)
geranial (26.31 percent)
neral (23.32 percent)

Compound	Hunan oil	Yunnan oil	Fujian oil
α -pinene	2.20	1.60	3.57
camphene	1.10	3.50	1.30
6-methyl-5-hepten-2-one	7.12	3.10	7.40
β -pinene	1.50	-	3.16
sabinene	0.75	-	2.33
p-cymene	0.10	0.30	0.10
limonene	14.04	11.60	17.49
linalool	3.45	2.50	4.88
2-propenyl-3-methyl-4-hydroxy-2-cyclopentene [†]	0.75	-	1.40
camphor	0.10	0.80	0.93
citronellal	1.70	7.60	0.69
pulegone	0.80	-	3.01
α -terpineol	1.60	1.50	2.30
geranial	37.80	*	26.55
neral	24.00	*	20.47
piperitone	0.10	-	0.10
geraniol	0.10	1.10	0.10
α -humulene	0.40	1.20	0.82
pseudoionone [†]	0.10	-	0.10
geranyl acetate	-	0.90	-
safrole	-	0.90	-

[†]questionable identity; *combined value for these two compounds is 62.50

A survey report on the essential oil resources of China (Zhu and Ding, 1991) reported that there were some quantitative variations in *L. cubeba* oil produced in different regions of China. A summary of these analytical results can be found in T-2.

Lis-Balchin et al. (1996) found that the three major constituents of *L. cubeba* oil were:

limonene (12.7 percent)
neral (33.1 percent)
geranial (44.8 percent)

Thappa et al. (1996) used a combination of analytical techniques, including GC, GC/MS and ¹H-NMR, on isolated constituents to examine some oils of Vietnamese origin. One of these oils was *L. cubeba*. *Litsea cubeba*, which is distributed abundantly throughout the northern part of Vietnam, was found to yield a fruit oil of 4-5 percent. The components identified in this oil were:

α -pinene (0.6 percent)
 β -pinene (1.3 percent)
limonene (0.7 percent)
6-methyl-5-hepten-2-one & 1,8-cineole (1.5 percent)
citronellal (6.2 percent)

linalool (2.5 percent)
terpinen-4-ol (2.0 percent)
borneol (0.1 percent)
 α -terpineol (0.5 percent)
geranial (30.5 percent)
neral (50.4 percent)
 β -caryophyllene (0.7 percent)
caryophyllene oxide & elemol (0.55 percent)

The main constituents of the fruit oil of *L. cubeba* (known as *mejankari* in India) were found by Gogoi et al. (1997) to be:

6-methyl-5-hepten-2-one (1.5 percent)
limonene (0.02 percent)
linalool (0.2 percent)
neral (40.7 percent)
geranial (51.9 percent)

Wright (1999) reported that the main and olfactorily important constituents of *L. cubeba* oil were as follows:

geranial (41 percent)
neral (34 percent)
limonene (8 percent)
6-methyl-5-hepten-2-one (4 percent)
myrcene (3 percent)
linalyl acetate (2 percent)
linalool (2 percent)
geraniol (1 percent)
nerol (1 percent)

β -caryophyllene (0.5 percent)
citronellal (0.5 percent)

The safrole content of *L. cubeba* oil was determined to be 0.04 percent (Anon, 2002).

An oil of *L. cubeba* was analyzed by Kubeczka and Formacek (2002) using a combination of capillary GC and ^{13}C -NMR spectroscopy. The constituents identified in this oil can be seen as follows:

α -pinene (1.86 percent)
camphene (0.72 percent)
 β -pinene (1.32 percent)
sabinene (0.80 percent)
myrcene (1.75 percent)
 α -phellandrene (0.41 percent)
limonene (12.76 percent)
 β -phellandrene (0.04 percent)
1,8-cineole (0.42 percent)
 γ -terpinene (0.04 percent)
(E)- β -ocimene (0.05 percent)
p-cymene (0.08 percent)
terpinolene (0.11 percent)
6-methyl-5-hepten-2-one (0.66 percent)
citronellal (0.54 percent)
 α -copaene (0.07 percent)
camphor (0.15 percent)
isonerol (0.71 percent)
linalool (1.21 percent)
isogeranial (1.11 percent)
 β -caryophyllene (1.40 percent)
terpinen-4-ol (0.07 percent)
 α -humulene (0.14 percent)
neral (30.78 percent)
 α -terpineol (0.22 percent)
geranial (40.25 percent)
geranyl acetate (0.06 percent)
citronellol (0.06 percent)
nerol (0.46 percent)
geraniol (0.97 percent)
geranic acid (0.10 percent)

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