Progress in Essential Oils

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Atlas Cedar Needle Oil

A needle oil of *Cedrus atlantica* (Endl.) G. Manetti produced in Morocco was analyzed by Lahlou et al. (2000). The main constituents characterized in this oil were:

α-pinene (34.2%)
β-pinene (31.8%)
myrcene (17.3%)
β-phellandrene (1.6%)
limonene (5.1%)
α-terpineol (5.1%)
β-caryophyllene (1.6%)
α-copaene (0.3%)

Yassaa et al. (2000) measured the terpenoid composition in the ambient air surrounding trees of *C. atlantica* and identified the following volatile compounds:

α-pinene (53.3%)
camphene (12.6%)
cis-pinane[†] (1.1%)
myrcene (12.9%)
α-phellandrene (1.0%)
p-cymene (3.2%)
limonene (11.3%)
cis-linalool oxide[f] (1.6%)
linalool (2.7%)
α-fenchyl alcohol (0.3%)

[†]incorrect identification
[f]furanoid form

They were also able to show that the limonene and α-fenchyl alcohol were characterized in their (R)–(+)–forms.

Boudarene et al. (2004a) analyzed twig and needle oils produced from trees of Algerian origin using GC-FID and GC/MS. As needle oils are usually produced from needles and twigs their compositions are combined as can be seen as follows:

α-pinene (17.7–23.4%)
camphene (1.3–1.8%)
β-pinene (1.3%)
myrcene (0.3–2.7%)
o-cymene (0–0.2%)
p-cymene (0–0.7%)
β-phellandrene (0–0.9%)
limonene (0.5–1.1%)
perillene (0–0.8%)
fenchone (0–0.8%)
α-campholenal (0.7–0.9%)
trans-pinocarveol (0.8–1.2%)
verbenol* (0–0.4%)
pinocamphone (0–0.4%)
isopinocamphone (0–0.4%)
p-cymen-8-ol (0–1.4%)
α-terpineol (0.8–6.7%)
myrtenal (0–0.5%)
myrtenol (0–0.5%)
verbenone (0.4–1.0%)
carvone (t–0.1%)
isobornyl acetate (0–1.6%)
carvacrol (0–0.2%)
α-copaene (0–0.8%)
geranyl acetate (0–0.9%)
longifolene (0–0.2%)
β-caryophyllene (9.1–11.4%)
α-himachalene (0–1.3%)
α-humulene (2.0–2.3%)
ethyl (E)-cinnamate (0.5–2.1%)
γ-himachalene (0–1.6%)
γ-muurolene (0–2.9%)
γ-curcumene (0–0.3%)
β-himachalene (0–2.4%)
α-muurolene (0–1.5%)
α-dehydro-ar-himachalene (0–0.4%)
δ-cadinene (0–0.9%)
γ-dehydro-ar-himachalene (0–0.4%)
β-vetivenene (0–0.3%)
(E)-nerolidol (0–1.2%)
oxido-himachalene (t–0.6%)
caryophyllene oxide (5.5–10.3%)
longiborneol (0–0.2%)
humulene epoxide II (0.9–1.7%)
α-acorenol (0–0.4%)
T-muurolol (0–1.8%)
6-methyl-6-(3-methylphenyl)-2-heptanone (0–1.3%)
α-muurolol (0–1.1%)
himachalol (0–3.1%)
α-cadinol (0–2.2%)
khusinol (0–1.3%)
(E)-α-atlantone (0–0.3%)
bicyclovetivenol (0–0.1%)
(E,E)-farnesyl acetate (0–0.5%)
manoyl oxide (0–1.1%)
abietatriene (0–2.2%)
abietadiene (0–0.5%)
methyl sandaracopimarate[a] (0–0.2%)
dehydroabietal (0–0.3%)
4-epi-abietal (0–0.2%)
tricosane (0–0.7%)
methyl dehydroabietate (1.6%)
dehydroabietol (0.2%)
tetracosane (0.3%)
11-decyltetracosane (0–1.3%)

t = trace (<0.1%)
*correct isomer not identified
[a]tentative identification

Trace amounts (<0.1%) of sabinene, verbenene, 1,8-cineole, *cis*-sabinol, terpinen-4-ol, thuj-3-en-10-al, bornyl acetate, ar-curcumene, spathulenol and 1-epi-cubenol were also found in either the twig or needle oils, or both.

A needle oil of *C. atlantica* produced from plants harvested in Corsica was screened for its antibacterial activity by Rossi et al. (2007). The major components of this oil that were characterized were:

α-pinene (63.1%)
β-pinene (4.5%)
myrcene (4.8%)
limonene (6.0%)

Unfortunately, no other components were identified in this oil.

Finally, it is of interest to note that Boudarene et al. (2004b) analyzed two oils produced by hydrodistillation of the seeds of *C. atlantica* harvested from eastern and central Algeria.

The oils ranged in composition as follows:

tricyclene (0.1%)
α-pinene (5.5–37.1%)
camphene (0–1.5%)
β-pinene (1.9–8.6%)
butylbenzene (0–1.1%)
myrcene (0.6–3.6%)
α-terpinene (0–0.2%)
p-mentha-1,3,8-triene (0–0.1%)
limonene (0.6–2.5%)
β-phellandrene (0.1–2.4%)
verbenene (0–0.2%)
γ-terpinene (0–0.3%)
p-cymene (0–0.4%)
terpinolene (0–0.5%)
perillene (t–0.1%)
6-campherenol (0–0.2%)
p-cymenene (0–0.2%)
linalool (0.2–0.7%)
α-campholenal (0.3–0.6%)
camphor (0–0.4%)
cis-β-terpineol (0.3–0.4%)
pinocarvone (0.5–0.6%)
bornyl acetate (4.0–5.4%)
camphene hydrate (0–0.4%)
terpinen-4-ol (0.6–1.2%)
myrtenal (0.6%)
trans-pinocarveol (1.4–1.6%)
(E)-β-farnesene (1.9–6.8%)
trans-verbenol (1.2–2.9%)
α-terpineol (0.8–1.4%)
borneol (0–1.1%)
verbenone (0.7–1.6%)
α-phellandren-8-ol (0–1.0%)
carvone (0–0.2%)
geranyl acetate (0.8–1.2%)
myrtenol (0.5–0.7%)
trans-carveol (0–0.4%)
p-cymen-8-ol (0.3–0.6%)
(Z)-β-damascenone (t–0.1%)
dendrolasin (t–0.2%)
thymol (0–0.4%)
dimethylthiophene (0–1.1%)
13-epi-manoyl oxide (0–0.2%)
abietadiene (0–1.9%)
abietatriene (0–0.2%)
manool (8.3–20.7%)

t = trace (<0.1%)

M. Lahlou, R. Berrada, A. Agoumi and M. Hmamouchi, *The potential effectiveness of essential oils in the control of human head lice in Morocco*. Internat. J. Aromatherap., **10**, 108–123 (2000).

N. Yassaa, B.Y. Meklati and A. Cecinato, *Evaluation of monoterpenic biogenic volatile organic compounds in ambient air around* Eucalyptus globulus, Pinus halepensis *and* Cedrus atlantica *trees growing in Algiers city area by chiral and achiral capillary gas chromatography.* Atmosph. Environ., **34**, 2809–2816 (2000).

L. Boudarene, L. Rahim, A. Baaliouamer and B.Y. Meklati, *Analysis of Algerian essential oils from twigs, needles and wood of* Cedrus atlantica *G. Manetti by GC/MS*. J. Essent. Oil Res., **16**, 531–534 (2004a).

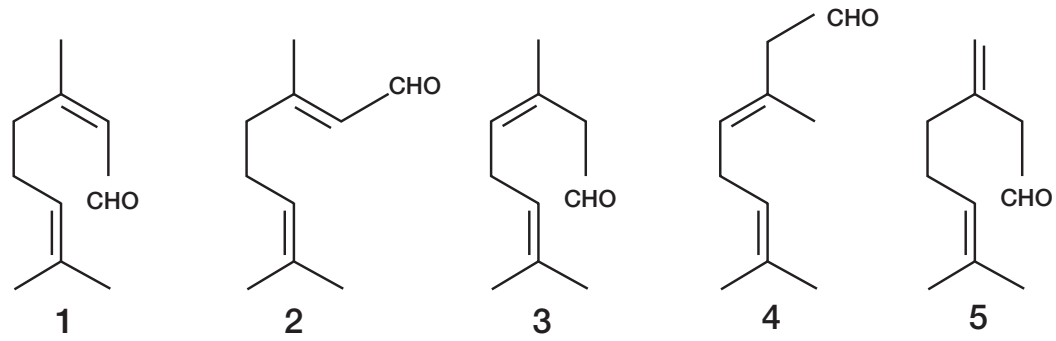
L. Boudarene, A. Baaliouamer, B.Y. Meklati and C. Scharff, *Composition of the seed oils from Algerian* Cedrus atlantica *G. Manetti*. J. Essent. Oil Res., **16**, 61–63 (2004b).

P-G. Rossi, L. Berti, J. Panighi, A. Luciani, J. Maury, A. Muselli, D. de Rocca Serra, M. Gonny and J-M. Bolla, *Antibacterial action of essential oils from Corsica.* J. Essent. Oil Res., **19**, 176–182 (2007).

Litsea cubeba Oil

Litsea cubeba oil is produced from the berries of *Litsea cubeba* (Lour.) Pers. in China. The annual volume of oil produced in 2007 was 760 tonnes (Lawrence 2009).

1. Neral, 2. geranial, 3. isoneral (also known as (Z)-isocitral or isocitral #1), 4. isogeranial (also known as (E)-isocitral or isocitral #2), 5. exo-isocitral (also known as isocitral #3) **F-1**



Using high resolution gas chromatography combined with isotope ratio mass spectrometry Caja et al. (2007) showed that the technique could be used to prove authenticity of citral (neral + geranial) in *Litsea cubeba* oils.

Williams (2008) reported that a commercial oil of *Litsea cubeba* contained the following components:

α-pinene (1.1%)
6-methyl-5-hepten-2-ene (1.2%)
sabinene (0.9%)
β-pinene (0.9%)
myrcene (1.2%)
limonene (12.5%)
1,8-cineole (1.3%)
linalool (1.2%)
citronellal (1.0%)
neral (31.4%)
geranial (41.5%)

Trace amounts (<0.1%) of camphene, 6-methyl-5-hepten-2-ol, α-phellandrene, γ-terpinene, terpinolene, borneol, terpinen-4-ol, α-terpineol, piperitone, geraniol, β-caryophyllene, α-humulene, citronellol and nerol.

A commercial oil of *Litsea cubeba* that was screened as a fumigant for its antitermitic activity by Seo et al. (2009) was determined to possess the following composition:

α-pinene (1.2%)
camphene (0.3%)
sabinene (1.5%)
6-methyl-5-hepten-1-one (1.3%)
β-pinene (1.1%)
myrcene (0.7%)
1,8-cineole (1.2%)
limonene (14.6%)
linalool (1.4%)
verbenol* (0.4%)
citronellal (0.6%)
α-terpineol (0.4%)
nerol (0.3%)
neral (30.3%)
geraniol (0.5%)
geranial (39.2%)
β-caryophyllene (0.6%)

*correct isomer not identified

In addition the authors examined the enantiomeric distribution of three monoterpene hydrocarbons using chiral GC. The results of this study were as follows:

(1R,5R)-(+)-α-pinene (58%) : (1S,5S)-(–)-α-pinene (42%)
(1R,5R)-(+)-β-pinene (27%) : (1S,5S)-(–)-β-pinene (73%)
(4R)-(+)-limonene (98%) : (4S)-(–)-limonene (2%)

Milchard et al. (2010) analyzed a commercial oil of *Litsea cubeba* and found that it contained:

α-pinene (1.1%)
camphene (0.3%)
6-methyl-5-hepten-2-one (1.9%)
sabinene (0.9%)
β-pinene (0.9%)
myrcene (1.2%)
limonene (12.0%)
1,8-cineole (0.8%)
linalool (1.5%)
isocitral #1 (0.2%)
citronellal (0.8%)
isocitral #2 (0.8%)
isocitral #3 (1.4%)
α-terpineol (0.5%)
citronellol (0.2%)
nerol (1.4%)
neral (29.3%)
geraniol (0.8%)
geranial (39.6%)
β-caryophyllene (0.7%)

Unfortunately the authors did not clarify the isocitrals, as a result this clarification can be seen in **F-1**.

M. Del Mar Caja, C. Preston, M. Kempf and P. Scheier, *Flavor authentication studies of α-ionone, β-ionone, and α-ionol from various sources*. J. Agric. Food Chem., **55**, 6700–6704 (2007).

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