Progress in Essential Oils

Brian M. Lawrence, Consultant

Roman Chamomile Oil

Some samples of Roman chamomile that were produced from plants grown in Morocco were analyzed for their major constituents by Lahlou et al. (2000). The components characterized in these oils were:

isobutyl butyrate (2.0–9.0%)
isobutyl methacrylate (1.0–3.0%)
isobutyl isobutyrate (3.0–5.0%)
2-methylbutyl methacrylate (0.5–1.5%)
isobutyl angelate + isoamyl methacrylate (30.0–45.0%)
methallyl angelate* (6.0–10.0%)
2-methylbutyl angelate (3.0–7.0%)
isoamyl angelate (12.0–22.0%)
pinocarvone (1.3–4.0%)
trans-pinocarveol (2.0–5.0%)

* also known as 2-methyl-2-propenyl angelate

An oil and a supercritical fluid CO_2 extract that were produced from the flowers of Roman chamomile plants grown in Iran from seeds obtained from Hungary were the subject of analysis by Omidbaigi et al. (2003). The constituents characterized in these two isolates are shown in **T-1**. As can be seen, the authors only characterized 73.8% of the oil and a mere 24.3% of the extract. They concluded the obvious—that the oil contained more volatiles than the extract.

The same authors (Omidbaigi et al., 2004) reported the same results for the oil composition, though this time they compared oils produced from shade-dried flowers (as before), sun-dried flowers and oven-dried (40º C) flowers. The compositional range of the oils produced from flowers dried by the latter two processes can be seen as follows:

isobutyl isobutyrate (1.4–1.8%)
heptanol (0.5–1.2%)
α-pinene (0.5–0.6%)
β-pinene (1.3–1.8%)
propyl angelate (< 0.1%)
2-methylbutyl isobutyrate (1.0–1.1%)
isoamyl isobutyrate (6.0–6.3%)
isobutyl angelate (28.2–29.8%)
propyl tiglate (10.8–13.1%)
isoamyl 2-methylbutyrate (3.9–4.5%)
trans-pinocarveol (< 0.1–1.4%)
isoamyl angelate (4.2–6.7%)
2-methylbutyl angelate (11.6–17.2%)
pinocarvone (< 0.1–0.4%)

The authors found that the oil yield for shade-dried, sun-dried and oven-dried flowers were 1.87%, 0.40% and 0.95%, respectively. Also, it should be noted that only 73.7–81.6% of the oils were characterized.

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 (2001).

R. Omidbaigi, F. Sefidkon and F. Kazemi, *Roman chamomile oil: Comparison between hydrodistillation and supercritical fluid extraction*. J. Essent. Oil Bear. Plants, **6**, 191–194 (2003).

R. Omidbaigi, F. Sefidkon and F. Kazemi, *Influence of drying methods on the essential oil content and composition of Roman chamomile*. Flav. Fragr. J., **19**, 196–198 (2004).

T-1 Comparative percentage composition of an oil and a supercritical fluid CO_2 extract (SFE) of Roman chamomile

Compound	Oil	SFE
isobutyl isobutyrate	1.5	0.1
heptanol	1.0	0.3
α-pinene	0.4	0.4
camphene	t	0.3
β-pinene	1.6	0.1
propyl angelate	0.8	0.3
2-methylbutyl isobutyrate	t	0.4
isoamyl isobutyrate	5.2	1.4
isobutyl angelate	25.9	1.1
propyl tiglate	12.0	2.3
isoamyl 2-methylbutyrate	4.1	2.8
trans-pinocarveol	1.3	0.9
isoamyl angelate	6.6	4.2
2-methylbutyl angelate	13.0	8.6
pinocarvone	0.4	1.1
Total	**73.8**	**24.3**

t = trace (<0.1%)

Flouve Oil and Absolute

Rarely used in flavor and fragrance due to a lack of availability, isolates of flouve (oil and absolute) possess a strong sweet, coumarinic tobacco-like odor. The absolute is reminiscent of some well-known English pipe tobaccos. It is obtained either by extraction or distillation of the flowering tops of a forage grass found in the Mediterranean region, botanically known as *Anthoxanthum odoratum* L.

Tava (1996) determined that coumarin was the major component of a distillate of *A. odoratum*. A few years ago, this author (Lawrence, 1997) analyzed a distillate obtained from a commercial sample of flouve absolute. This distillate was found to contain the following components:

coumarin (68.0%)
carvacrol (9.7%)
(E)-β-ionone (3.1%)
2-phenethyl alcohol (3.1%)
ethyl methylmaleimide (3.0%)
benzyl alcohol (2.1%)
dihydroactinodiolide (2.1%)
geranyl acetone (1.3%)
neryl acetone (1.2%)
phenol (1.0%)
thymol (1.0%)
eugenol (1.0%)
γ-nonalactone (1.0%)
ethyl tetradecanoate (1.0%)
ethyl hexadecanoate (0.4%)
2-undecanone (0.2%)

Trace amounts (< 0.1%) of phytone, neophytadiene, acenaphthalene, biphenyl 2-octene, l-heptadecene, octyne, 3-methylcoumarin, phytol, isophytol, ethyl hexanoate, ethyl octanoate, ethyl nonanoate, ethyl decanoate, ethyl dodecanoate, ethyl octadecanoate, ethyl 4-methyl-octadecanoate, ethyl oleate, ethyl linoleate and ethyl linolenate were also characterized in the distillate. In addition, the following acids were found as trace components: dodecanoic, tetradecanoic, pentadecanoic, hexadecanoic, heptadecanoic, octadecanoic, nonadecanoic, eicosanic, docosanic, linoleic, linolenic and p-hydroxycinnamic.

Oils produced from freshly harvested and dried sweet vernal grass were analyzed by GC-FID and GC/MS (Tava, 2001). The components identified in the oil from fresh material were as follows:

(E)-2-hexenol (0.1%)
(Z)-3-hexenol (0.1%)
1-octen-3-ol (0.1%)
(Z)-3-hexenyl acetate (0.1%)
octanol (0.1%)
nonanal (0.2%)
2-hydroxyacetophenone (0.1%)
p-vinylguaiacol (0.1%)
coumarin (96.3%)
nonadecane (0.1%)
methyl linolenate (0.4%)
tricosane (0.2%)
pentacosane (0.2%)
heptacosane (0.2%)
nonacosane (0.1%)

Trace amounts (< 0.1%) of amyl alcohol, hexanal, hexanol, heptanal, a 2,4-hexadienal isomer, benzaldehyde, heptanol, 6-methyl-5-hepten-2-ol, octanal, salicylaldehyde, benzyl alcohol, phenylacetaldehyde, o-cresol, (Z)-2-octenal, 2-phenethanol, 2-nitrophenol, phenylpropanal, borneol, coumaran, (E)-2-decenal, (E,E)-2,4-decadienal, p-vinylguaicol methyl ether, 3,4-dihydrocoumarin, dihydroactinodiolide, (E)-β-ionone, 3-methylcoumarin, a methyl coumarin isomer, dodecanoic acid, dimethylcoumarin isomer, heptadecane, tetradecanoic acid, 6,10,14-trimethyl-2-pentadecanone, phytol, hexadecanoic acid, methyl linoleate, heneicosane, squalene and hentriacontane were found.

The oil produced from the hay of *A. odoratum* was also determined by Tava (2001) to possess the following composition:

valeraldehyde (0.6%)
methyl butyrate[a] (0.7%)
amyl alcohol (0.1%)
hexanal (0.3%)
methyl valeratea (0.3%)
(Z)-3-hexenol (0.1%)
methyl hexanoate[a] (0.6%)
benzaldehyde (0.1%)
heptanol (0.1%)
6-methyl-5-hepten-2-ol (0.2%)
octanal (0.1%)
(Z)-3-hexenyl acetate (0.1%)
benzyl alcohol (0.1%)
phenylacetaldehyde (0.1%)
(Z)-2-octenol (0.1%)
octanol (3.4%)
methyl benzoate[a] (0.1%)
nonanal (0.3%)
2-phenethyl alcohol (0.2%)
methyl octanoate[a] (0.9%)
phenylpropanal (0.3%)
borneol (0.1%)
coumaran (0.1%)
2-decanone (0.3%)
methylnonanoate[a] (1.0%)
(E)-2-decenal (0.1%)
p-vinylguaicol (1.9%)
methyl decanoate[a] (0.3%)
p-vinylguaiacol methyl ether[b] (0.6%)
3,4-dihydrocoumarin (0.4%)
methyl (E)-cinnamate[a] (0.4%)
2-dodecanone (0.1%)
methyl undecanoate[a] (0.3%)
coumarin (46.8%)
3,4-dimethoxybenzaldehyde (0.2%)
β-ionone epoxide (0.1%)
methyl dodecanoate[a] (1.3%)
methyl tridecanoate[a] (0.5%)
heptadecane (0.1%)
methyl tetradecanoate[a] (1.6%)
methyl pentadecanoate[a] (0.4%)
6,10,14-trimethyl-2-pentadecanone (1.4%)
nonadecane (0.1%)
methyl hexadecanoate[a] (9.9%)
phytol (0.8%)
methyl linolenate[a] (1.2%)
methyl linoleate[a] (3.0%)
methyl oleate[a] (0.5%)
methyl octadecanoate[a] (0.2%)
tricosane (0.5%)
pentacosane (0.4%)
heptacosane (0.3%)
nonacosane (0.2%)

[a] treatment of oil with CH_2N_2 yielded methyl esters of existing fatty acids;
[b] also known as 3,4-dimethoxystyrene

A. Tava, *GC and GC/MS analyses of volatile components from forage plants*. Herba Polon., **42**, 231–236 (1996).

B.M. Lawrence, Unpublished data (1997).

A. Tava, *Coumarin-containing grass: Volatiles from sweet vernal grass* (Anthoxanthum *odoratum L.*). J. Essent. Oil Res., **13**, 367–370 (2001).

Artemisia ludoviciana Oil

Estafiate, or iztauyat, is one of the most popular phytotherapeutic remedies used in Mexico. It is known taxonomically as *Artemisia ludoviciana* Nutt. subsp. *mexicana* Nutt. (syn. *A. mexicana* Willd.; *A. vulgaris* L. var. *mexicana* Torr. et A. Gray; *A. vulgaris* L. subsp. *mexicana* H.M. Hall et Clem.). A second subspecies of *A. lucoviciana* subsp. *albula* Nutt. is also known, but the only material sold in Mexico is *A. ludoviciana* subsp. *mexicana*. The interest in this species stems from the fact that although an oil of *A. ludoviciana* is being marketed in the United States, its specific use is unknown to this reviewer. In addition, an advertisement for the oil and hydrosol of *A. ludoviciana* as "owyhee" regularly appears in *Perfumer & Flavorist* magazine.

A survey of the literature reveals that an oil produced from plants collected in Puntadela Loma (Mexico) was found to contain:

α-pinene (3%)
α-phellandrene (4%)
camphor (52%)
borneol (25%)

In addition, two sesquiterpene lactones, namely acetylmatricarin and achillin, were found as components of a hydrocarbon extract.

Alexander and Epstein (1975) isolated (1R,3R)-chrysanthemol from a pentane extract of *A. ludoviciana* collected near Salt Lake City.

Ohno et al. (1980) determined that *A. ludoviciana var. ludoviciana* was rich in sesquiterpene lactones. Blust and Hopkins (1987) analyzed an extract of *A. ludoviciana* of North American origin and found that it contained α-thujene, α-pinene, camphene, β-pinene, myrcene, p-cymene, 1,8-cineole, artemisia ketone, α-thujone, camphor, borneol, bornyl acetate and a number of sesquiterpene lactones.

Further sesquiterpene lactones were characterized by Jakupovic et al. (1991). These authors also confirmed that the main volatile components were camphor and borneol.

Although no compositional data on the oil of *A. ludoviciana* was presented by Heinrich (2002), a survey of the use of the plant in the treatment of gastrointestinal problems along with other complaints can be found in this treatise.

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K. Alexander and W.W. Epstein, *Studies on the biogenesis of non-head-to-tail monoterpenes. The isolation of (1R,3R)-chrysanthemol from* Artemisia ludoviciana. J. Org. Chem., **40**, 2576 (1975).

N. Ohno, J. Gershenzon, C. Roan and T.J. Mabry, *11-13-Dehydrodesacetylmatricarin and other sesquiterpene lactones from* Artemisia ludoviciana *var.* ludoviciana *and the identity of artecanin and chrysartemin B*. Phytochemistry, **19**, 103–106 (1980).

M.H. Blust and T.L. Hopkins, *Gustatory responses of a specialist and a generalist grasshopper to terpenoids of* Artemisia ludoviciana. Entomol. Experim. Applic., **45**, 37–46 (1987).

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M. Heinrich, *Ethnobotany, Phytochemistry and Biological/Pharmacological Activities of Artemisia ludoviciana subsp.* mexicana *(Estafiate)*. In: Artemisia. Edit., C.W. Wright, pp. 107–117, Taylor and Francis, London, UK (2002).

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