

**Date :** January 23, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19A10-ORA01-1-CC  
**Customer identification :** Organic Lemon  
**Type :** Essential oil  
**Source :** *Citrus x limon*  
**Customer :** Organic Aromas Inc.

**ANALYSIS**

**Method:** PC-PA-014-17J19 - Analysis of the composition of an essential oil, or other volatile liquid, by FAST GC-FID (in French); identifications validated by GC-MS.

**Analyst :** Sylvain Mercier, M. Sc., Chimiste

**Analysis date :** January 14, 2019

Checked and approved by :

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Alexis St-Gelais, M. Sc., chimiste 2013-174

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Light yellow liquid

**Refractive index:**  $1.4738 \pm 0.0003$  (20 °C)

*CONCLUSION*

No adulterant, contaminant or diluent has been detected using this method.

ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
2-Methyl-3-buten-2-ol	tr	tr	Aliphatic alcohol
Octane	0.01	0.01	Alkane
Nonane	tr	tr	Alkane
Tricyclene	0.01	0.01	Monoterpene
$\alpha$ -Thujene	0.36	0.35	Monoterpene
$\alpha$ -Pinene	1.65	1.64	Monoterpene
Camphene	0.05	0.05	Monoterpene
Sabinene	12.46*	1.78	Monoterpene
$\beta$ -Pinene	[12.46]*	10.61	Monoterpene
6-Methyl-5-hepten-2-one	0.01	0.01	Aliphatic ketone
Myrcene	1.23	1.22	Monoterpene
$\alpha$ -Phellandrene	0.03*	0.02	Monoterpene
Pseudolimonene	[0.03]*	tr	Monoterpene
Octanal	0.01	0.02	Aliphatic aldehyde
$\Delta^3$ -Carene	0.01	0.01	Monoterpene
$\alpha$ -Terpinene	0.11	0.11	Monoterpene
para-Cymene	1.08	1.25	Monoterpene
Limonene	68.19*	67.52	Monoterpene
1,8-Cineole	[68.19]*	0.25	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.05	7.04*	Monoterpene
(E)- $\beta$ -Ocimene	0.11	0.11	Monoterpene
$\gamma$ -Terpinene	7.01	[7.04]*	Monoterpene
cis-Sabinene hydrate	0.03	0.03	Monoterpenic alcohol
Octanol	0.01	0.01*	Aliphatic alcohol
Terpinolene	0.29	0.29	Monoterpene
trans-Sabinene hydrate	0.02	0.02	Monoterpenic alcohol
Linalool	0.08	0.08	Monoterpenic alcohol
Nonanal	0.03	0.03	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.02	0.02	Monoterpenic alcohol
cis-Limonene oxide	0.07	0.07	Monoterpenic ether
trans-Limonene oxide	0.05	0.05	Monoterpenic ether
Camphor	0.01	0.01	Monoterpenic ketone
Epoxyterpinolene	0.03	0.03	Monoterpenic ether
Citronellal	0.04	0.04	Monoterpenic aldehyde
Borneol	tr	0.11*	Monoterpenic alcohol
Terpinen-4-ol	0.03	0.02	Monoterpenic alcohol
Isogeranial	0.01	[0.01]*	Monoterpenic aldehyde
para-Cymen-8-ol	0.01	0.01	Monoterpenic alcohol
$\alpha$ -Terpineol	0.10	[0.11]*	Monoterpenic alcohol
Decanal	0.01	0.03	Aliphatic aldehyde
trans-Carveol	0.02	0.02	Monoterpenic alcohol
2,3-Epoxyneral?	0.01		Monoterpenic aldehyde
2,3-Epoxygeranial?	0.03		Monoterpenic aldehyde
Neral	0.68*	0.72*	Monoterpenic aldehyde
Carvone	[0.68]*	0.02	Monoterpenic ketone
Geraniol	0.03	0.03	Monoterpenic alcohol
Perillaldehyde	0.01	0.01	Monoterpenic aldehyde
Geranial	1.11	1.12	Monoterpenic aldehyde

<i>cis</i> -Ascaridole glycol?	0.01	0.01	Monoterpenic alcohol
Limonen-10-ol	0.01	0.01	Monoterpenic alcohol
Undecanal	0.01	0.01	Aliphatic aldehyde
<i>trans</i> -para-Mentha-2,8-diene-1-hydroperoxide	0.01		Monoterpenic peroxide
Unknown	0.02	0.01	Unknown
Citronellyl acetate	0.03	[0.72]*	Monoterpenic ester
Neryl acetate	0.49	1.19*	Monoterpenic ester
$\beta$ -Bourbonene	tr	0.01	Sesquiterpene
Geranyl acetate	0.28	0.29	Monoterpenic ester
Dodecanal	0.01	0.01*	Aliphatic aldehyde
$\beta$ -Caryophyllene	0.29*	0.69*	Sesquiterpene
<i>cis</i> - $\alpha$ -Bergamotene	[0.29]*	0.05	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.44	[0.69]*	Sesquiterpene
$\alpha$ -Humulene	0.02	0.02	Sesquiterpene
$\beta$ -Santalene	0.05*	0.01	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	[0.05]*	0.04	Sesquiterpene
Geranyl propionate	0.01	0.01	Monoterpenic ester
$\beta$ -Selinene	0.01	0.01	Sesquiterpene
<i>trans</i> - $\beta$ -Bergamotene	0.03	0.04	Sesquiterpene
Valencene	0.02	tr	Sesquiterpene
Bicyclogermacrene	0.01	0.01	Sesquiterpene
( <i>Z</i> )- $\alpha$ -Bisabolene	0.06	0.01	Sesquiterpene
$\beta$ -Bisabolene	0.66	[1.19]*	Sesquiterpene
$\gamma$ -Cadinene	0.01	0.01	Sesquiterpene
( <i>Z</i> )- $\gamma$ -Bisabolene	0.01	[0.01]*	Sesquiterpene
$\delta$ -Cadinene	0.02	0.02	Sesquiterpene
( <i>E</i> )- $\alpha$ -Bisabolene	0.02	0.02	Sesquiterpene
Spathulenol	0.12	0.10	Sesquiterpenic alcohol
Caryophyllene oxide	0.04	0.04	Sesquiterpenic ether
Isospathulenol	0.01	0.01*	Sesquiterpenic alcohol
Unknown	0.04	0.02	Oxygenated sesquiterpene
Unknown	0.02	0.03	Oxygenated sesquiterpene
$\alpha$ -Bisabolol	0.04	0.04	Sesquiterpenic alcohol
Myristic acid	0.04	0.05	Aliphatic acid
meta-Camphorene	tr	[0.01]*	Diterpene
Citropten	0.04	0.06	Furanocoumarin
Palmitic acid	0.16	0.21	Aliphatic acid
Bergapten	0.01		Furanocoumarin
Oleic acid	0.08		Aliphatic acid
<i>cis</i> -Vaccenic acid?	0.05		Aliphatic acid
Stearic acid	0.20	0.28	Aliphatic acid
<b>Total identified</b>	<b>98.38%</b>	<b>98.05%</b>	

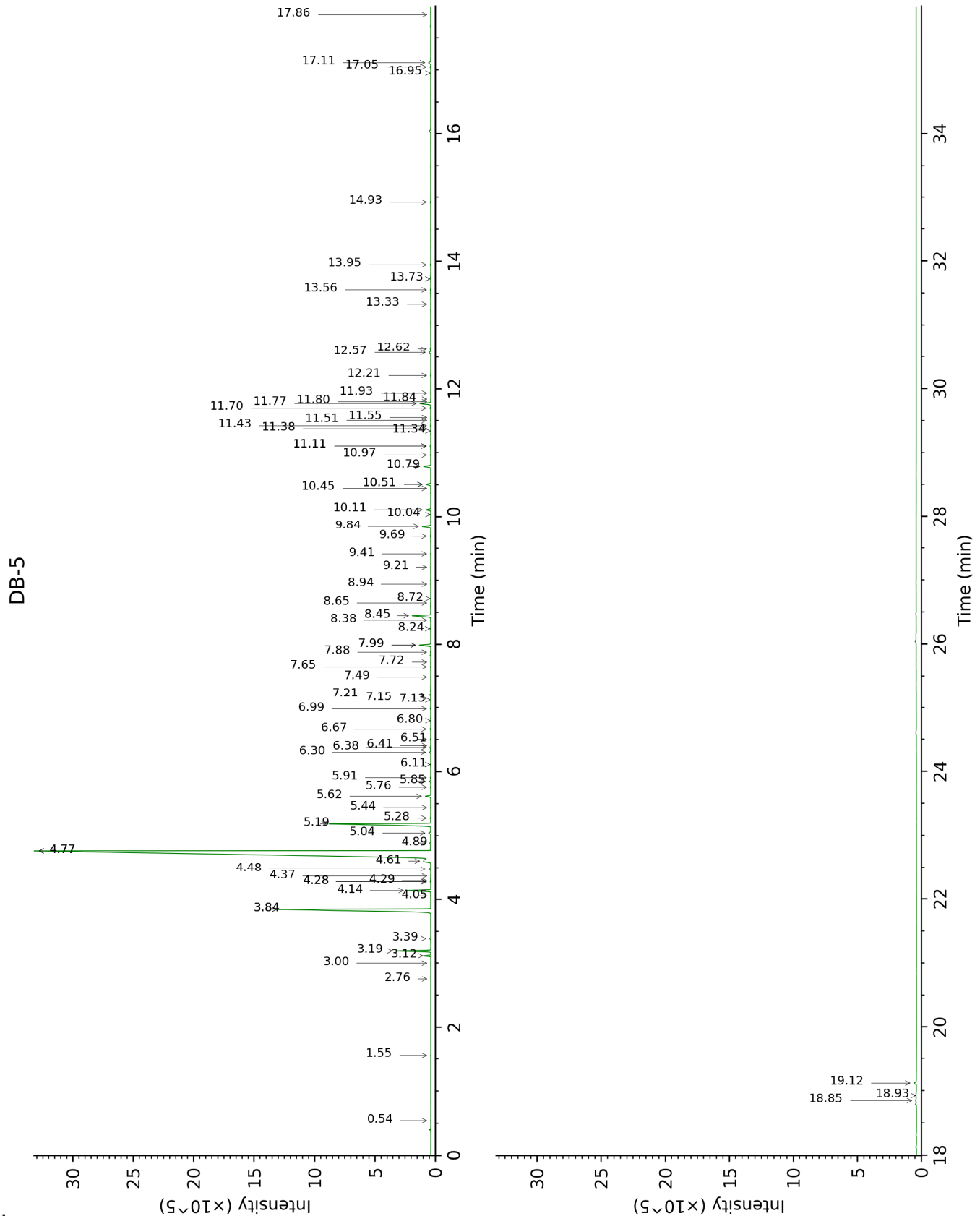
\*: Two or more compounds are coeluting on this column

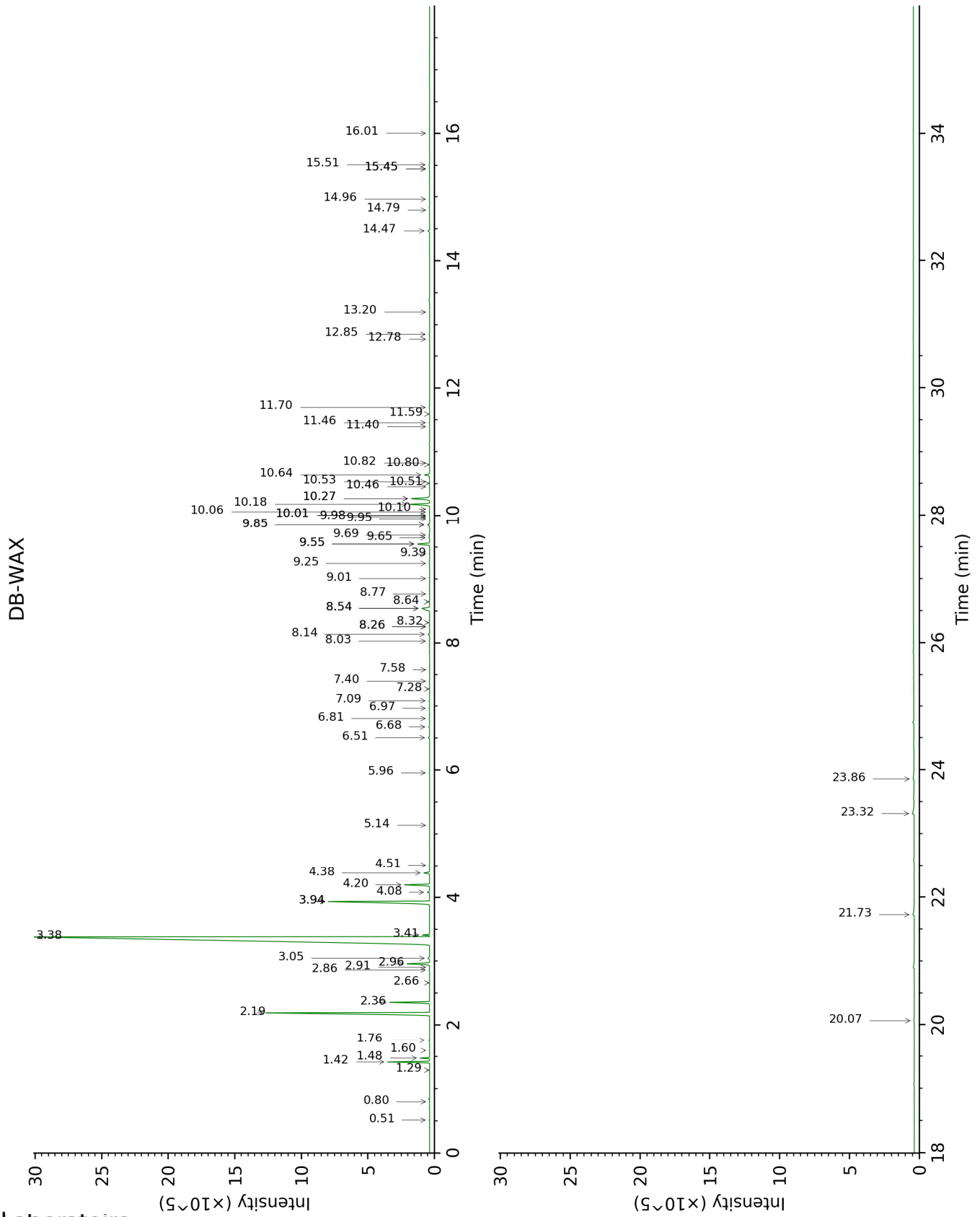
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
2-Methyl-3-buten-2-ol	0.54	604	tr	1.60	1014	tr
Octane	1.55	799	0.01	0.51	791	0.01
Nonane	2.76	900	tr	0.80	896	tr
Tricyclene	3.00	917	0.01	1.29	975	0.01
$\alpha$ -Thujene	3.12	924	0.36	1.48	1003	0.35
$\alpha$ -Pinene	3.20	929	1.65	1.42	994	1.64
Camphene	3.39	942	0.05	1.76	1029	0.05
Sabinene	3.84*	972	12.46	2.36	1086	1.78
$\beta$ -Pinene	3.84*	972	[12.46]	2.19	1070	10.61
6-Methyl-5-hepten-2-one	4.05	986	0.01	5.14	1305	0.01
Myrcene	4.14	991	1.23	2.96	1136	1.22
$\alpha$ -Phellandrene	4.28*	1000	0.03	2.86	1128	0.02
Pseudolimonene	4.28*	1000	[0.03]	2.91	1131	tr
Octanal	4.29	1002	0.01	4.51	1257	0.02
$\Delta$ 3-Carene	4.36	1006	0.01	2.66	1112	0.01
$\alpha$ -Terpinene	4.48	1013	0.11	3.05	1142	0.11
para-Cymene	4.61	1021	1.08	4.20	1232	1.25
Limonene	4.77*	1032	68.19	3.38	1169	67.52
1,8-Cineole	4.77*	1032	[68.19]	3.41	1171	0.25
(Z)- $\beta$ -Ocimene	4.89	1039	0.05	3.94*	1213	7.04
(E)- $\beta$ -Ocimene	5.04	1049	0.11	4.08	1224	0.11
$\gamma$ -Terpinene	5.19	1058	7.01	3.94*	1213	[7.04]
cis-Sabinene hydrate	5.28	1064	0.03	6.97	1429	0.03
Octanol	5.44	1074	0.01	8.26*	1526	0.01
Terpinolene	5.62	1085	0.29	4.38	1247	0.29
trans-Sabinene hydrate	5.76	1094	0.02	8.03	1509	0.02
Linalool	5.85	1100	0.08	8.14	1517	0.08
Nonanal	5.91	1104	0.03	5.96	1354	0.03
trans-para-Mentha-2,8-dien-1-ol	6.11	1117	0.02	9.01	1585	0.02
cis-Limonene oxide	6.30	1129	0.07	6.51	1394	0.07
trans-Limonene oxide	6.38	1134	0.05	6.68	1407	0.05
Camphor	6.41	1136	0.01	7.28	1452	0.01
Epoxyterpinolene	6.51	1142	0.03	6.81	1417	0.03
Citronellal	6.67	1152	0.04	7.09	1438	0.04
Borneol	6.80	1161	tr	9.85*	1653	0.11
Terpinen-4-ol	6.99	1173	0.03	8.64	1557	0.02
Isogeranial	7.13	1182	0.01	8.26*	1526	[0.01]
para-Cymen-8-ol	7.15	1184	0.01	11.59	1800	0.01
$\alpha$ -Terpineol	7.21	1188	0.10	9.85*	1653	[0.11]
Decanal	7.49	1206	0.01	7.40	1461	0.03



<i>trans</i> -Carveol	7.65	1217	0.02	11.46	1788	0.02
2,3-Epoxyneral?	7.72	1222	0.01			
2,3-Epoxygeranial?	7.88	1232	0.03			
Neral	7.99*	1240	0.68	9.55*	1629	0.72
Carvone	7.99*	1240	[0.68]	10.06	1670	0.02
Geraniol	8.24	1258	0.03	11.70	1809	0.03
Perillaldehyde	8.38	1267	0.01	10.80	1732	0.01
Geranial	8.45	1272	1.11	10.18	1680	1.12
<i>cis</i> -Ascaridole glycol?	8.65	1285	0.01	14.80	2097	0.01
Limonen-10-ol	8.72	1290	0.01	13.20	1945	0.01
Undecanal	8.94	1306	0.01	8.77	1566	0.01
<i>trans</i> -para-Mentha-2,8-diene-1-hydroperoxide	9.21	1321	0.01			
Unknown [m/z 82, 59 (44), 41 (43), 95 (31), 43 (29), 81 (24)...]	9.41	1335	0.02	12.78	1906	0.01
Citronellyl acetate	9.69	1355	0.03	9.55*	1629	[0.72]
Neryl acetate	9.84	1366	0.49	10.27*	1688	1.19
$\beta$ -Bourbonene	10.04	1380	tr	7.58	1475	0.01
Geranyl acetate	10.11	1385	0.28	10.64	1719	0.29
Dodecanal	10.45	1409	0.01	10.01*	1666	0.01
$\beta$ -Caryophyllene	10.51*	1414	0.29	8.54*	1549	0.69
<i>cis</i> - $\alpha$ -Bergamotene	10.51*	1414	[0.29]	8.32	1531	0.05
<i>trans</i> - $\alpha$ -Bergamotene	10.79	1435	0.44	8.54*	1549	[0.69]
$\alpha$ -Humulene	10.97	1448	0.02	9.39	1616	0.02
$\beta$ -Santalene	11.11*	1458	0.05	9.25	1604	0.01
( <i>E</i> )- $\beta$ -Farnesene	11.11*	1458	[0.05]	9.65	1637	0.04
Geranyl propionate	11.34	1476	0.01	11.40	1783	0.01
$\beta$ -Selinene	11.38	1478	0.01	9.98	1664	0.01
<i>trans</i> - $\beta$ -Bergamotene	11.42	1482	0.03	9.69	1640	0.04
Valencene	11.51	1488	0.02	9.95	1662	tr
Bicyclogermacrene	11.55	1492	0.01	10.10	1674	0.01
( <i>Z</i> )- $\alpha$ -Bisabolene	11.70	1503	0.06	10.46	1703	0.01
$\beta$ -Bisabolene	11.77	1508	0.66	10.27*	1688	[1.19]
$\gamma$ -Cadinene	11.80	1510	0.01	10.51	1707	0.01
( <i>Z</i> )- $\gamma$ -Bisabolene	11.84	1514	0.01	10.01*	1666	[0.01]
$\delta$ -Cadinene	11.93	1521	0.02	10.53	1710	0.02
( <i>E</i> )- $\alpha$ -Bisabolene	12.21	1543	0.02	10.82	1734	0.02
Spathulenol	12.57	1571	0.12	14.47	2066	0.10
Caryophyllene oxide	12.62	1575	0.04	12.85	1912	0.04
Isospathulenol	13.33	1633	0.01	15.45*	2163	0.01
Unknown [m/z 94, 43 (89), 41 (67), 122 (46), 69 (41)...222]	13.56	1651	0.04	14.96	2114	0.02

Unknown [m/z 69, 95 (100), 41 (89), 109 (68), 67 (61)...222]	13.73	1665	0.02	16.01	2219	0.03
$\alpha$ -Bisabolol	13.95	1684	0.04	15.51	2169	0.04
Myristic acid	14.93	1768	0.04	20.07	2673	0.05
meta-Camphorene	16.95	1952	tr	15.45*	2163	[0.01]
Citropten	17.04	1961	0.04	23.86	3168	0.06
Palmitic acid	17.11	1968	0.16	21.72	2880	0.21
Bergapten	17.86	2040	0.01			
Oleic acid	18.85	2140	0.08			
cis-Vaccenic acid?	18.92	2148	0.05			
Stearic acid	19.12	2168	0.20	23.32	3092	0.28
<b>Total identified</b>		<b>98.38%</b>			<b>98.05%</b>	
<b>Total reported</b>		<b>98.47%</b>			<b>98.11%</b>	

\*: Two or more compounds are coeluting on this column

[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied  
R.T.: Retention time (minutes)  
R.I.: Retention index