

**Date :** January 21, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19A18-PTH02-1-CC

**Customer identification :** Grapefruit (Pink) - USA - G50107811R

**Type :** Essential oil

**Source :** *Citrus x paradisi* cv. Red

**Customer :** Plant Therapy

**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 :** Lindsay Girard, B. Sc.

**Analysis date :** January 21, 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:** Bright orange liquid

**Refractive index:** 1.4743 ± 0.0003 (20 °C)

*ISO 3053:2005 - OIL OF GRAPEFRUIT, OBTAINED BY EXPRESSION*

<b>Compound</b>	<b>Min. %</b>	<b>Max. %</b>	<b>Observed %</b>	<b>Complies?</b>
Nootkatone	0.01	0.80	0.20	Yes
β-Caryophyllene	0.2	0.5	0.3	Yes
Neral	0.02	0.04	0.03	Yes
Decanal	0.1	0.6	0.3	Yes
Nonanal	0.04	0.10	0.06	Yes
Octanal	0.2	0.8	0.4	Yes
Limonene	92	96	91	No
Myrcene	1.5	2.5	1.7	Yes
β-Pinene	0.05	0.20	0.08	Yes
Sabinene	0.1	0.6	0.4	Yes
α-Pinene	0.2	0.6	0.5	Yes
<b>Refractive index</b>	1.4740	1.4790	1.4743	Yes

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Heptanal	tr	tr	Aliphatic aldehyde
$\alpha$ -Thujene	tr	0.01	Monoterpene
$\alpha$ -Pinene	0.47	0.48	Monoterpene
Camphene	tr	tr	Monoterpene
Thuja-2,4(10)-diene	0.01	0.02	Monoterpene
Sabinene	0.48*	0.43	Monoterpene
$\beta$ -Pinene	[0.48]*	0.08	Monoterpene
Heptanol	tr	0.01	Aliphatic alcohol
Myrcene	1.69	1.71	Monoterpene
$\alpha$ -Phellandrene	0.43*	0.03	Monoterpene
Octanal	[0.43]*	0.40	Aliphatic aldehyde
$\Delta^3$ -Carene	0.02	tr	Monoterpene
Limonene	90.56*	91.19	Monoterpene
$\beta$ -Phellandrene	[90.56]*	0.21	Monoterpene
para-Cymene	[90.56]*	0.01	Monoterpene
(Z)- $\beta$ -Ocimene	0.01	0.01	Monoterpene
(E)- $\beta$ -Ocimene	0.10	0.10	Monoterpene
$\gamma$ -Terpinene	0.02	0.02	Monoterpene
cis-Sabinene hydrate	0.01	0.01	Monoterpenic alcohol
Octanol	0.06	0.06	Aliphatic alcohol
Terpinolene	0.01	0.02	Monoterpene
Linalool	0.11	0.12	Monoterpenic alcohol
Nonanal	0.06	0.06	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.03	0.02	Monoterpenic alcohol
cis-Limonene oxide	0.02	0.02	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.01	0.06*	Monoterpenic alcohol
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
(E)-Myroxide	0.01	0.05*	Monoterpenic ether
Citronellal	0.06	0.07	Monoterpenic aldehyde
Terpinen-4-ol	0.01	tr	Monoterpenic alcohol
$\alpha$ -Terpineol	0.05	0.06	Monoterpenic alcohol
trans-Isopiperitenol	0.01	0.01	Monoterpenic alcohol
Decanal	0.30	0.30	Aliphatic aldehyde
Octyl acetate	0.04	[0.05]*	Aliphatic ester
trans-Carveol	0.01	0.01	Monoterpenic alcohol
cis-Carveol	0.01	0.01	Monoterpenic alcohol
Citronellol	0.01	0.02	Monoterpenic alcohol
Neral	0.05*	[0.06]*	Monoterpenic aldehyde
Carvone	[0.05]*	0.02	Monoterpenic ketone
(E)-Isogeraniol?	0.01	tr	Monoterpenic alcohol
Geraniol	tr	0.01	Monoterpenic alcohol
Isopiperitenone	tr	tr	Monoterpenic ketone
Geranial	0.06	0.09*	Monoterpenic aldehyde
Unknown	0.01	tr	Oxygenated monoterpene
Undecanal	0.01	0.02	Aliphatic aldehyde
cis-para-Mentha-2,8-diene-1-hydroperoxide	tr		Monoterpenic peroxide
para-Mentha-1,8-diene-4-	tr		Monoterpenic peroxide

hydroperoxide			
α-Terpinyl acetate	0.01	0.01	Monoterpenic ester
Limonene hydroperoxide IV	0.01		Monoterpenic peroxide
Neryl acetate	0.01	0.01	Monoterpenic ester
α-Copaene	0.08	0.08	Sesquiterpene
Geranyl acetate	0.04	0.05	Monoterpenic ester
β-Cubebene	0.07	0.08	Sesquiterpene
β-Elemene	0.02	0.28*	Sesquiterpene
Dodecanal	0.04	0.03	Aliphatic aldehyde
β-Caryophyllene	0.25	[0.28]*	Sesquiterpene
α-Humulene	0.03	0.03	Sesquiterpene
(E)-β-Farnesene	0.02	0.02	Sesquiterpene
Germacrene D	0.07	0.07	Sesquiterpene
Bicyclogermacrene	0.02	[0.09]*	Sesquiterpene
α-Murolene	0.01	[0.09]*	Sesquiterpene
Cubebol	tr	tr	Sesquiterpenic alcohol
δ-Cadinene	0.09	0.09	Sesquiterpene
α-Elemol	0.02	0.03	Sesquiterpenic alcohol
(E)-Nerolidol	0.01	0.01	Sesquiterpenic alcohol
Germacrene D-4-ol	0.03*	0.01	Sesquiterpenic alcohol
Spathulenol	[0.03]*	0.01	Sesquiterpenic alcohol
Caryophyllene oxide	0.02	0.01	Sesquiterpenic ether
β-Sinensal	0.02	0.02	Sesquiterpenic aldehyde
(2E,6E)-Farnesol	tr	tr	Sesquiterpenic alcohol
Myristic acid	0.03		Aliphatic acid
Nootkatone	0.20	0.21	Sesquiterpenic ketone
Palmitic acid	0.12		Aliphatic acid
Bergapten	0.01		Furanocoumarin
Osthole	0.05		Coumarin
Linoleic acid	0.02		Aliphatic acid
Oleic acid	0.06		Aliphatic acid
7-Methoxy-8-(2-formyl-2-methylpropyl)coumarin	0.09		Coumarin
Isoauraptene	0.07		Coumarin
Meranzin	0.19		Coumarin
Auraptanol	0.01		Coumarin
Meranzin hydrate	0.01		Coumarin
Auraptene	0.57		Coumarin
Epoxyauraptene	0.14		Coumarin
Tangeretin	0.09		Flavonoid
3,5,6,7,8,3',4'-Heptamethoxyflavone?	0.06		Flavonoid
3,3',4',5,6,7,8-Heptamethoxyflavone	0.03		Flavonoid
<b>Total identified</b>	<b>97.41%</b>	<b>96.78%</b>	

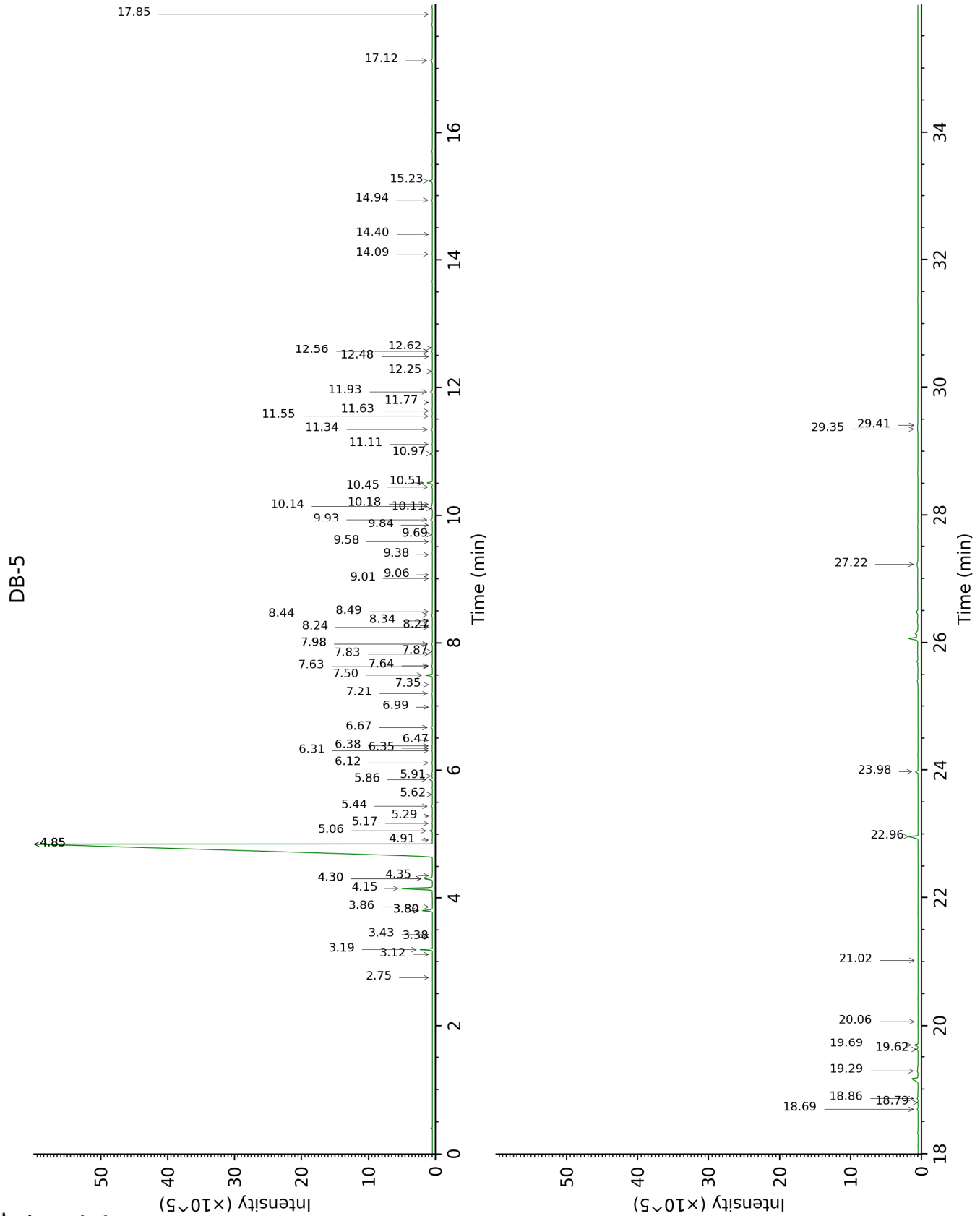
\*: Two or more compounds are coeluting on this column

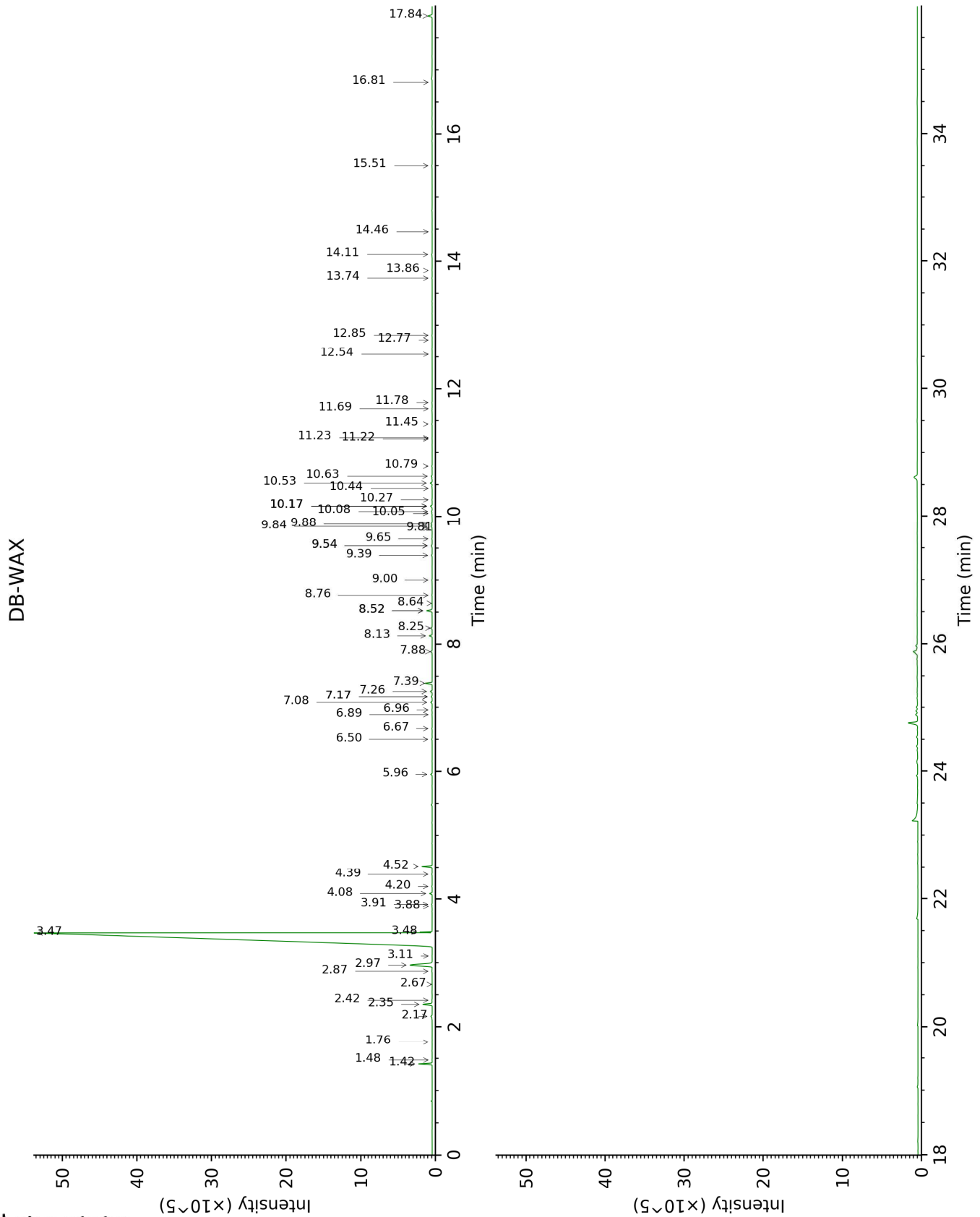
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Heptanal	2.75	900	tr	3.11	1147	tr
$\alpha$ -Thujene	3.12	924	tr	1.48	1003	0.01
$\alpha$ -Pinene	3.19	929	0.47	1.42	994	0.48
Camphene	3.38	942	tr	1.76	1029	tr
Thuja-2,4(10)-diene	3.43	945	0.01	2.42	1092	0.02
Sabinene	3.80*	969	0.48	2.35	1086	0.43
$\beta$ -Pinene	3.80*	969	[0.48]	2.17	1068	0.08
Heptanol	3.86	973	tr	6.89	1423	0.01
Myrcene	4.15	992	1.69	2.97	1136	1.71
$\alpha$ -Phellandrene	4.30*	1002	0.43	2.87	1128	0.03
Octanal	4.30*	1002	[0.43]	4.52	1257	0.40
$\Delta^3$ -Carene	4.35	1005	0.02	2.67	1113	tr
Limonene	4.85*	1037	90.56	3.47	1176	91.19
$\beta$ -Phellandrene	4.85*	1037	[90.56]	3.48	1177	0.21
para-Cymene	4.85*	1037	[90.56]	4.20	1232	0.01
(Z)- $\beta$ -Ocimene	4.91	1041	0.01	3.88	1209	0.01
(E)- $\beta$ -Ocimene	5.06	1050	0.10	4.08	1224	0.10
$\gamma$ -Terpinene	5.17	1057	0.02	3.91	1211	0.02
cis-Sabinene hydrate	5.29	1064	0.01	6.96	1428	0.01
Octanol	5.44	1074	0.06	8.25	1526	0.06
Terpinolene	5.62	1086	0.01	4.39	1247	0.02
Linalool	5.86	1100	0.11	8.13	1517	0.12
Nonanal	5.91	1104	0.06	5.96	1354	0.06
trans-para-Mentha-2,8-dien-1-ol	6.12	1117	0.03	9.00	1585	0.02
cis-Limonene oxide	6.31	1129	0.02	6.50	1394	0.02
cis-para-Mentha-2,8-dien-1-ol	6.35	1132	0.01	9.54*	1628	0.06
trans-Limonene oxide	6.38	1134	0.01	6.67	1406	0.01
(E)-Myroxide	6.47	1140	0.01	7.17*	1444	0.05
Citronellal	6.67	1153	0.06	7.08	1437	0.07
Terpinen-4-ol	6.99	1173	0.01	8.64	1556	tr
$\alpha$ -Terpineol	7.21	1188	0.05	9.84	1653	0.06
trans-Isopiperitenol	7.35	1197	0.01	10.44	1702	0.01
Decanal	7.50	1206	0.30	7.39	1460	0.30
Octyl acetate	7.63	1216	0.04	7.17*	1444	[0.05]
trans-Carveol	7.64	1216	0.01	11.45	1788	0.01
cis-Carveol	7.83	1229	0.01	11.78	1817	0.01
Citronellol	7.86	1232	0.01	10.79	1732	0.02
Neral	7.98*	1240	0.05	9.54*	1628	[0.06]
Carvone	7.98*	1240	[0.05]	10.05	1670	0.02
(E)-Isogeraniol?	8.24	1258	0.01	11.22	1768	tr
Geraniol	8.27	1259	tr	11.69	1808	0.01
Isopiperitenone	8.34	1264	tr	11.23	1769	tr
Geranial	8.44	1271	0.06	10.17*	1679	0.09
Unknown [m/z 41, 43 (84), 72 (81), 97 (90), 95 (60)... 150 (4)]	8.49	1274	0.01	12.77	1905	tr



Undecanal	9.01	1306	0.01	8.76	1566	0.02
<i>cis</i> -para-Mentha-2,8-diene-1-hydroperoxide	9.06	1310	tr			
para-Mentha-1,8-diene-4-hydroperoxide	9.38	1333	tr			
α-Terpinyl acetate	9.58	1347	0.01	9.81	1650	0.01
Limonene hydroperoxide IV	9.69	1355	0.01			
Neryl acetate	9.84	1366	0.01	10.26	1687	0.01
α-Copaene	9.93	1372	0.08	7.26	1451	0.08
Geranyl acetate	10.11	1385	0.04	10.63	1718	0.05
β-Cubebene	10.14	1387	0.07	7.88	1497	0.08
β-Elemene	10.18	1390	0.02	8.52*	1547	0.28
Dodecanal	10.44	1409	0.04	10.08	1672	0.03
β-Caryophyllene	10.51	1414	0.25	8.52*	1547	[0.28]
α-Humulene	10.97	1448	0.03	9.39	1616	0.03
( <i>E</i> )-β-Farnesene	11.11	1459	0.02	9.65	1637	0.02
Germacrene D	11.34	1476	0.07	9.88	1656	0.07
Bicyclogermacrene	11.55	1492	0.02	10.17*	1679	[0.09]
α-Muurolene	11.63	1498	0.01	10.17*	1679	[0.09]
Cubebol	11.77	1508	tr	12.54	1884	tr
δ-Cadinene	11.93	1521	0.09	10.53	1709	0.09
α-Elemol	12.25	1546	0.02	14.11	2031	0.03
( <i>E</i> )-Nerolidol	12.48	1564	0.01	13.86	2006	0.01
Germacrene D-4-ol	12.56*	1571	0.03	13.74	1995	0.01
Spathulenol	12.56*	1571	[0.03]	14.46	2065	0.01
Caryophyllene oxide	12.62	1575	0.02	12.84	1912	0.01
β-Sinensal	14.09	1696	0.02	15.50	2168	0.02
(2 <i>E</i> ,6 <i>E</i> )-Farnesol	14.40	1722	tr	16.81	2303	tr
Myristic acid	14.94	1768	0.03			
Nootkatone	15.24	1794	0.20	17.84	2416	0.21
Palmitic acid	17.12	1968	0.12			
Bergapten	17.85	2039	0.01			
Osthole	18.69	2124	0.05			
Linoleic acid	18.79	2134	0.02			
Oleic acid	18.86	2141	0.06			
7-Methoxy-8-(2-formyl-2-methylpropyl)coumarin	19.29	2185	0.09			
Isoauraptene	19.62	2220	0.07			
Meranzin	19.69	2227	0.19			
Auraptenol	20.06	2268	0.01			
Meranzin hydrate	21.02	2373	0.01			
Auraptene	22.96	2601	0.57			
Epoxyaurapten	23.98	2727	0.14			
Tangeretin	27.22	3140	0.09			
3,5,6,7,8,3',4'-Heptamethoxyflavone?	29.35	3319	0.06			
3,3',4',5,6,7,8-Heptamethoxyflavone	29.40	3322	0.03			
<b>Total identified</b>		<b>97.41%</b>			<b>96.78%</b>	

<b>Total reported</b>	<b>97.42%</b>	<b>96.79%</b>
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\*: 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