

Date : May 21, 2019

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

**Internal code :** 19E10-PTH02-1-SCC

**Customer identification :** Grapefruit Org - GK010393R

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

**Analysis date :** May 19, 2019

Checked and approved by :



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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Orange liquid

**Refractive index:** 1.4758 ± 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	0.10	Yes
β-Caryophyllene	0.2	0.5	0.3	Yes
Neral	0.02	0.04	0.04	Yes
Decanal	0.1	0.6	0.3	Yes
Nonanal	0.04	0.10	0.07	Yes
Octanal	0.2	0.8	0.3	Yes
Limonene	92	96	91	No
Myrcene	1.5	2.5	1.9	Yes
β-Pinene	0.05	0.20	0.03	No
Sabinene	0.1	0.6	0.3	Yes
α-Pinene	0.2	0.6	0.5	Yes
<b>Refractive index</b>	1.4740	1.4790	1.4758	Yes

*CONCLUSION*

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

The oil marginally does not comply with the ISO standard for grapefruit oil.

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
α-Thujene	tr	tr	Monoterpene
α-Pinene	0.54	0.52	Monoterpene
Camphene	tr	tr	Monoterpene
Thuja-2,4(10)-diene	0.01	0.27*	Monoterpene
β-Pinene	0.29*	0.03	Monoterpene
Sabinene	[0.29]*	[0.27]*	Monoterpene
Heptanol	[0.29]*	0.01	Aliphatic alcohol
Myrcene	1.91	1.90	Monoterpene
α-Phellandrene	0.30*	0.03	Monoterpene
Pseudolimonene	[0.30]*	tr	Monoterpene
Octanal	[0.30]*	0.26	Aliphatic aldehyde
Limonene	91.47*	90.96	Monoterpene
1,8-Cineole	[91.47]*	0.26	Monoterpenic ether
(Z)-β-Ocimene	0.01	0.01	Monoterpene
(E)-β-Ocimene	0.08	0.08	Monoterpene
Octanol	0.02	0.02	Aliphatic alcohol
Terpinolene	0.01	0.02	Monoterpene
Linalool	0.09	0.09	Monoterpenic alcohol
Nonanal	0.07	0.07	Aliphatic aldehyde
Heptyl acetate	0.01*	0.01	Aliphatic ester
(E)-4,8-Dimethylnona-1,3,7-triene	[0.01]*	0.01	Terpene derivative
trans-para-Mentha-2,8-dien-1-ol	0.01	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.01	0.01	Monoterpenic ether
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
Citronellal	0.08	0.08	Monoterpenic aldehyde
α-Terpineol	0.03	0.13*	Monoterpenic alcohol
Decanal	0.28	0.26	Aliphatic aldehyde
Octyl acetate	0.06*	0.06	Aliphatic ester
trans-Carveol	[0.06]*	tr	Monoterpenic alcohol
Citronellol	0.01	0.01	Monoterpenic alcohol
Neral	0.04	0.04	Monoterpenic aldehyde
Geranial	0.06	0.06	Monoterpenic aldehyde
Undecanal	0.02	0.02	Aliphatic aldehyde
α-Terpinyl acetate	0.02	0.03	Monoterpenic ester
Limonene hydroperoxide IV	0.02		Monoterpenic peroxide
Neryl acetate	0.01	0.01	Monoterpenic ester
α-Copaene	0.10	0.11	Sesquiterpene
Geranyl acetate	0.03	0.06	Monoterpenic ester
β-Elemene	0.02	0.30*	Sesquiterpene
Dodecanal	0.04	0.03	Aliphatic aldehyde
β-Caryophyllene	0.27	[0.30]*	Sesquiterpene
α-Humulene	0.04	0.05	Sesquiterpene
(E)-β-Farnesene	0.03	0.03	Sesquiterpene
Germacrene D	0.09	[0.13]*	Sesquiterpene
Bicyclogermacrene	0.03	0.03	Sesquiterpene
α-Murolene	0.03	0.02	Sesquiterpene
Cubebol	0.02	0.01	Sesquiterpenic alcohol
δ-Cadinene	0.11	0.11	Sesquiterpene

$\alpha$ -Elemol	0.02	0.02	Sesquiterpenic alcohol
( <i>E</i> )-Nerolidol	tr		Sesquiterpenic alcohol
Germacrene D-4-ol	0.03*	0.01	Sesquiterpenic alcohol
Spathulenol	[0.03]*		Sesquiterpenic alcohol
Caryophyllene oxide	0.02		Sesquiterpenic ether
$\beta$ -Sinensal	0.03	0.02	Sesquiterpenic aldehyde
Myristic acid	0.03		Aliphatic acid
Nootkatone	0.10	0.10	Sesquiterpenic ketone
Palmitic acid	0.16		Aliphatic acid
Bergapten	0.02		Furanocoumarin
Osthole	0.08		Coumarin
Linoleic acid	0.06		Aliphatic acid
Oleic acid	0.04		Aliphatic acid
<i>cis</i> -Vaccenic acid?	0.03		Aliphatic acid
Stearic acid	0.28		Aliphatic acid
Isoauraptene	0.07		Coumarin
Meranzin	0.13		Coumarin
Meranzin hydrate	0.01		Coumarin
Unknown	0.02		Coumarin
Auraptene	0.76		Coumarin
Epoxyaurapten	0.10		Coumarin
Tangeretin	0.02		Flavonoid
3,5,6,7,8,3',4'-Heptamethoxyflavone?	0.06		Flavonoid
3,3',4',5,6,7,8-Heptamethoxyflavone	0.01		Flavonoid
<b>Total identified</b>	<b>98.35%</b>	<b>96.16%</b>	

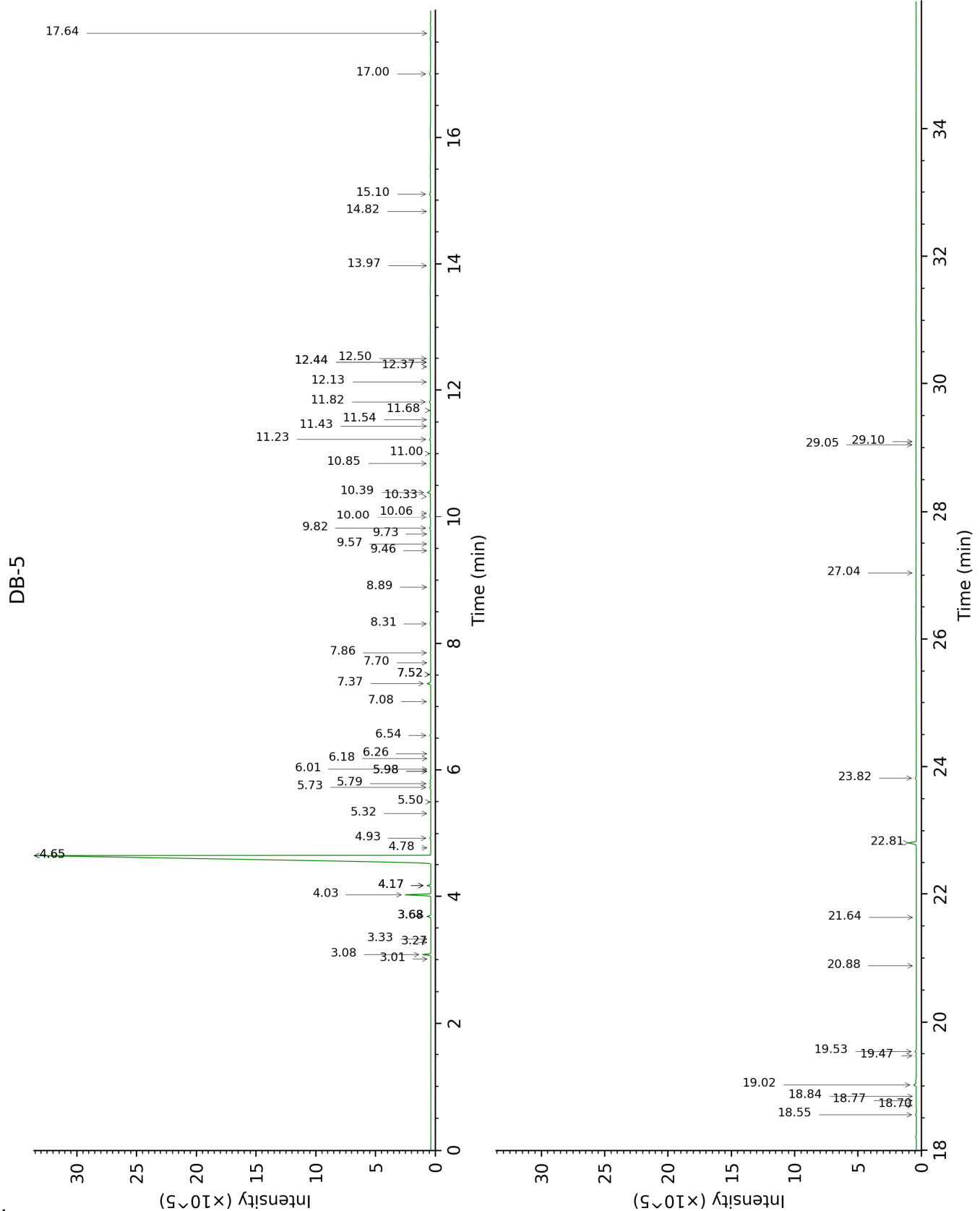
\*: Two or more compounds are coeluting on this column

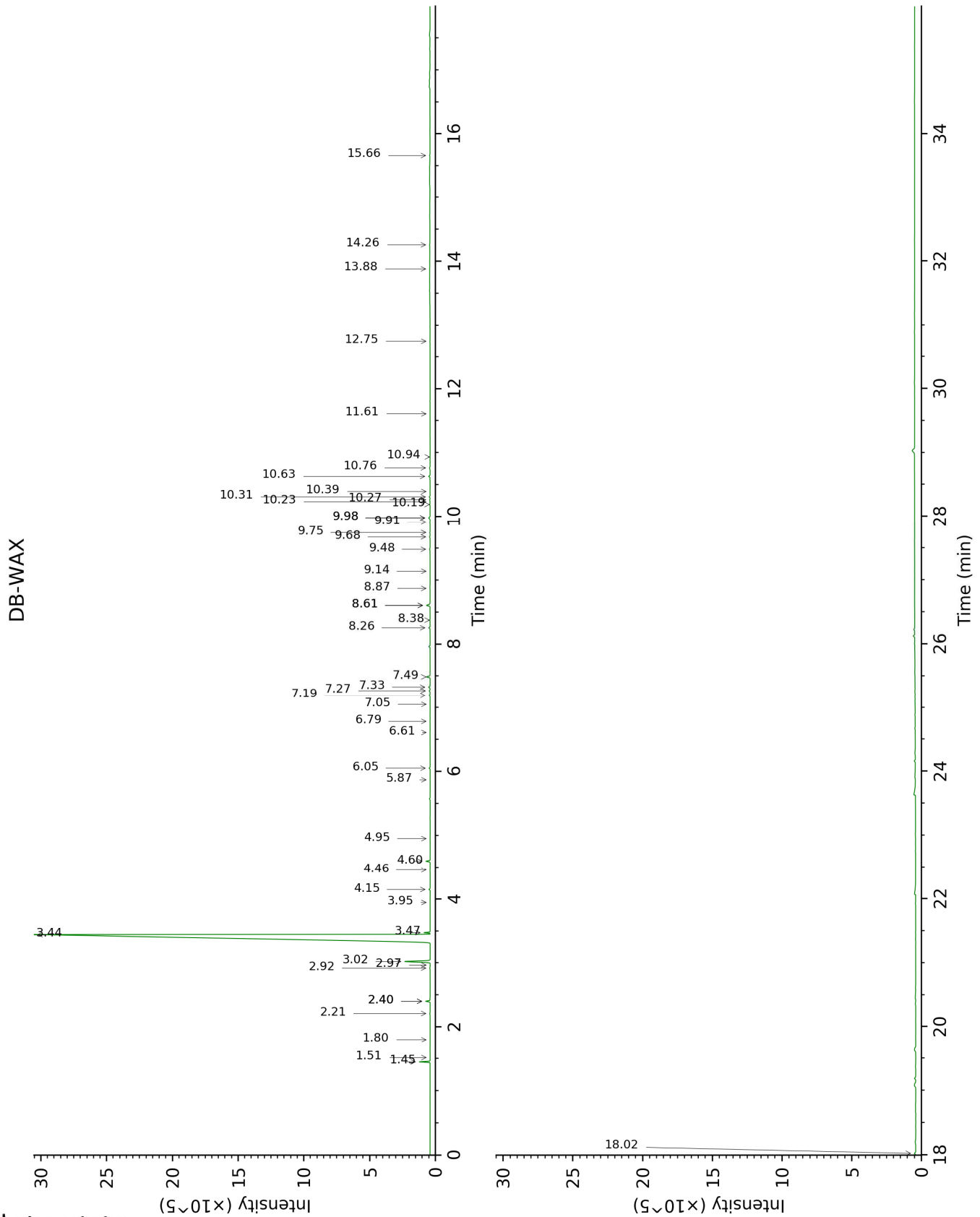
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
$\alpha$ -Thujene	3.01	925	tr	1.52	999	tr
$\alpha$ -Pinene	3.08	930	0.54	1.45	992	0.52
Camphene	3.28	942	tr	1.80	1027	tr
Thuja-2,4(10)-diene	3.33	946	0.01	2.40*	1085	0.27
$\beta$ -Pinene	3.68*	969	0.29	2.21	1066	0.03
Sabinene	3.68*	969	[0.29]	2.40*	1085	[0.27]
Heptanol	3.68*	969	[0.29]	7.05	1426	0.01
Myrcene	4.03	992	1.91	3.02	1134	1.90
$\alpha$ -Phellandrene	4.17*	1002	0.30	2.92	1126	0.03
Pseudolimonene	4.17*	1002	[0.30]	2.97	1130	tr
Octanal	4.17*	1002	[0.30]	4.60	1250	0.26
Limonene	4.65*	1032	91.47	3.44	1166	90.96
1,8-Cineole	4.65*	1032	[91.47]	3.47	1168	0.26
(Z)- $\beta$ -Ocimene	4.78	1040	0.01	3.95	1204	0.01
(E)- $\beta$ -Ocimene	4.93	1050	0.08	4.15	1218	0.08
Octanol	5.32	1074	0.02	8.38	1525	0.02
Terpinolene	5.50	1086	0.01	4.46	1240	0.02
Linalool	5.73	1100	0.09	8.26	1516	0.09
Nonanal	5.79	1104	0.07	6.05	1354	0.07
Heptyl acetate	5.98*	1117	0.01	5.87	1341	0.01
(E)-4,8-Dimethylnona-1,3,7-triene	5.98*	1117	[0.01]	4.95	1275	0.01
<i>trans</i> -para-Mentha-2,8-dien-1-ol	6.01	1119	0.01	9.14	1584	0.01
<i>cis</i> -Limonene oxide	6.18	1130	0.01	6.61	1394	0.01
<i>trans</i> -Limonene oxide	6.26	1135	0.01	6.78	1406	0.01
Citronellal	6.54	1154	0.08	7.19	1437	0.08
$\alpha$ -Terpineol	7.08	1189	0.03	9.98*	1651	0.13
Decanal	7.37	1208	0.28	7.49	1458	0.26
Octyl acetate	7.52*	1218	0.06	7.27	1442	0.06
<i>trans</i> -Carveol	7.52*	1218	[0.06]	11.61	1786	tr
Citronellol	7.70	1231	0.01	10.94	1730	0.01
Neral	7.86	1242	0.04	9.68	1627	0.04
Geranial	8.31	1274	0.06	10.31	1678	0.06
Undecanal	8.89	1308	0.02	8.87	1563	0.02
$\alpha$ -Terpinyl acetate	9.46	1348	0.02	9.91	1646	0.03
Limonene hydroperoxide IV	9.57	1356	0.02			
Neryl acetate	9.73	1367	0.01	10.40	1684	0.01
$\alpha$ -Copaene	9.82	1374	0.10	7.33	1446	0.11
Geranyl acetate	10.00	1386	0.03	10.76	1715	0.06
$\beta$ -Elemene	10.06	1391	0.02	8.61*	1543	0.30
Dodecanal	10.33	1410	0.04	10.19	1668	0.03
$\beta$ -Caryophyllene	10.39	1415	0.27	8.61*	1543	[0.30]
$\alpha$ -Humulene	10.85	1449	0.04	9.48	1611	0.05
(E)- $\beta$ -Farnesene	11.00	1461	0.03	9.75	1632	0.03
Germacrene D	11.23	1477	0.09	9.98*	1651	[0.13]
Bicyclogermacrene	11.43	1493	0.03	10.26	1674	0.03



α-Muurolene	11.54	1500	0.03	10.23	1671	0.02
Cubebol	11.68	1512	0.02	12.75	1887	0.01
δ-Cadinene	11.82	1522	0.11	10.63	1704	0.11
α-Elemol	12.13	1547	0.02	14.26	2026	0.02
(E)-Nerolidol	12.37	1566	tr			
Germacrene D-4-ol	12.44*	1572	0.03	13.88	1990	0.01
Spathulenol	12.44*	1572	[0.03]			
Caryophyllene oxide	12.50	1576	0.02			
β-Sinensal	13.97	1697	0.03	15.66	2164	0.02
Myristic acid	14.82	1770	0.03			
Nootkatone	15.10	1794	0.10	18.02	2412	0.10
Palmitic acid	17.00	1969	0.16			
Bergapten	17.64	2031	0.02			
Osthole	18.55	2122	0.08			
Linoleic acid	18.70	2136	0.06			
Oleic acid	18.77	2144	0.04			
cis-Vaccenic acid?	18.84	2151	0.03			
Stearic acid	19.02	2169	0.28			
Isoauraptene	19.47	2216	0.07			
Meranzin	19.53	2224	0.13			
Meranzin hydrate	20.88	2371	0.01			
Unknown [m/z 219, 247 (85), 217 (61), 161 (48), 189 (33), 232 (23)... 290 (18)]	21.64	2457	0.02			
Auraptene	22.81	2596	0.76			
Epoxyaurapten	23.82	2722	0.10			
Tangeretin	27.04	3135	0.02			
3,5,6,7,8,3',4'- Heptamethoxyflavone?	29.05	3313	0.06			
3,3',4',5,6,7,8- Heptamethoxyflavone	29.10	3316	0.01			
<b>Total identified</b>		<b>98.35%</b>			<b>96.16%</b>	
<b>Total reported</b>		<b>98.38%</b>			<b>96.16%</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