

**Date :** December 21, 2018

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 18L20-PTH06-1-DM

**Customer identification :** Blood Orange - Italy - O1010778R

**Type :** Essential oil

**Source :** *Citrus sinensis*

**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 :** December 21, 2018

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Orange liquid

**Refractive index:** 1.4745 ± 0.0003 (20 °C)

*ISO 3140:2011 - OIL OF SWEET ORANGE, OBTAINED BY PHYSICAL EXTRACTION OF THE PEEL*

Compound	Min. %	Max. %	Observed %	Complies?
β-Sinensal	0.01	0.06	0.03	Yes
Geranial	0.05	0.20	0.06	Yes
Valencene	0.01	0.40	0.12	Yes
Neral	0.03	0.10	0.05	Yes
Linalool	0.15	0.70	0.31	Yes
Decanal	0.1	0.7	0.2	Yes
Nonanal	0.01	0.06	0.04	Yes
Octanal	0.1	0.4	0.2	Yes
Limonene	93.0	96.0	93.0	Yes
Myrcene	1.5	3.5	1.9	Yes
Sabinene	0.2	0.8	0.4	Yes
β-Pinene	0.02	0.15	0.05	Yes
α-Pinene	0.4	0.8	0.5	Yes
<b>Refractive index</b>	1.4700	1.4760	1.4745	Yes

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
$\alpha$ -Thujene	0.01	0.01	Monoterpene
$\alpha$ -Pinene	0.52	0.52	Monoterpene
Camphene	0.01	tr	Monoterpene
Sabinene	0.44*	0.39	Monoterpene
$\beta$ -Pinene	[0.44]*	0.05	Monoterpene
Myrcene	1.87	1.85	Monoterpene
$\alpha$ -Phellandrene	0.25*	0.04	Monoterpene
Pseudolimonene	[0.25]*	tr	Monoterpene
Octanal	[0.25]*	0.21	Aliphatic aldehyde
$\Delta^3$ -Carene	0.17	0.17	Monoterpene
$\alpha$ -Terpinene	tr		Monoterpene
(Z)- $\beta$ -Ocimene	93.41*	0.01	Monoterpene
1,8-Cineole	[93.41]*	0.26	Monoterpenic ether
Limonene	[93.41]*	92.95	Monoterpene
para-Cymene	[93.41]*	0.01	Monoterpene
(E)- $\beta$ -Ocimene	0.02	0.02	Monoterpene
$\gamma$ -Terpinene	0.03	0.03	Monoterpene
cis-Sabinene hydrate	0.01	0.01*	Monoterpenic alcohol
Octanol	0.01	0.02	Aliphatic alcohol
Isoterpinolene	0.01	0.01	Monoterpene
Terpinolene	0.03	0.03	Monoterpene
Linalool	0.31	0.32	Monoterpenic alcohol
Nonanal	0.04	0.04	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.01	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.01		Monoterpenic ether
trans-Limonene oxide	0.01	0.01	Monoterpenic ether
Citronellal	0.05	0.05	Monoterpenic aldehyde
Terpinen-4-ol	0.01	0.01	Monoterpenic alcohol
$\alpha$ -Terpineol	0.04	0.06	Monoterpenic alcohol
Decanal	0.20	0.20	Aliphatic aldehyde
Octyl acetate	0.01	0.01	Aliphatic ester
trans-Carveol	0.01	0.01	Monoterpenic alcohol
Nerol	0.01	0.01	Monoterpenic alcohol
Neral	0.05	0.05	Monoterpenic aldehyde
Geraniol	0.01	0.01	Monoterpenic alcohol
Perillaldehyde	0.01	0.01	Monoterpenic aldehyde
Geranial	0.06	0.08*	Monoterpenic aldehyde
Limonen-10-ol	0.01	0.01	Monoterpenic alcohol
Undecanal	0.01	0.01	Aliphatic aldehyde
$\alpha$ -Cubebene	0.01	[0.01]*	Sesquiterpene
Neryl acetate	0.01	0.01	Monoterpenic ester
$\alpha$ -Copaene	0.02	0.02	Sesquiterpene
Geranyl acetate	0.01	0.01	Monoterpenic ester
$\beta$ -Elemene	0.01	0.03*	Sesquiterpene
Dodecanal	0.04	0.04	Aliphatic aldehyde
$\beta$ -Caryophyllene	0.02	[0.03]*	Sesquiterpene
$\beta$ -Copaene	0.02	0.02	Sesquiterpene
$\alpha$ -Humulene	0.01	0.01	Sesquiterpene

(E)- $\beta$ -Farnesene	0.01	0.01	Sesquiterpene
$\gamma$ -Muurolene	0.01	0.01	Sesquiterpene
Germacrene D	0.02	0.02	Sesquiterpene
Valencene	0.12	0.12	Sesquiterpene
Bicyclogermacrene	0.01	[0.08]*	Sesquiterpene
$\alpha$ -Muurolene	0.01	[0.08]*	Sesquiterpene
$\gamma$ -Cadinene	0.02	0.05*	Sesquiterpene
Zonarene	0.03*	[0.05]*	Sesquiterpene
$\delta$ -Cadinene	[0.03]*	[0.05]	Sesquiterpene
Caryophyllene oxide	0.01	0.01	Sesquiterpenic ether
$\beta$ -Sinensal	0.03	0.03	Sesquiterpenic aldehyde
$\alpha$ -Sinensal	0.02	0.02	Sesquiterpenic aldehyde
Myristic acid	0.04	0.05	Aliphatic acid
Hexadecanal	0.01	0.01	Aliphatic aldehyde
Palmitic acid	0.09	0.10	Aliphatic acid
Linoleic acid	0.05	0.05	Aliphatic acid
Oleic acid	0.03		Aliphatic acid
<i>cis</i> -Vaccenic acid?	0.05		Aliphatic acid
Stearic acid	0.22	0.36	Aliphatic acid
Tetramethoxyflavone isomer	0.03		Flavonoid
Tangeretin	0.01		Flavonoid
3,3',4',5,6,7,8-Heptamethoxyflavone	0.06		Flavonoid
Nobiletin	0.02		Flavonoid
<b>Total identified</b>	<b>98.69%</b>	<b>98.44%</b>	

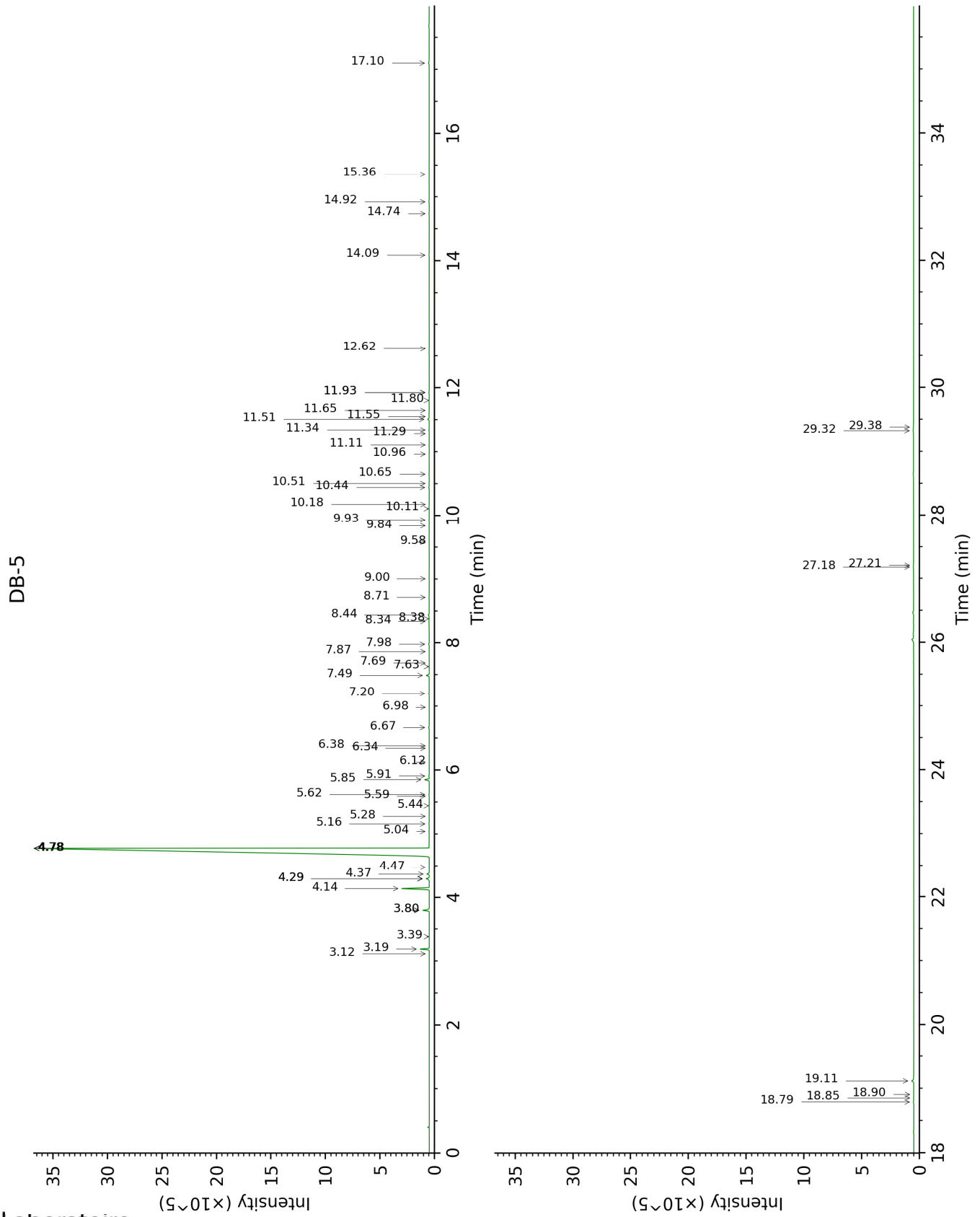
\*: Two or more compounds are coeluting on this column

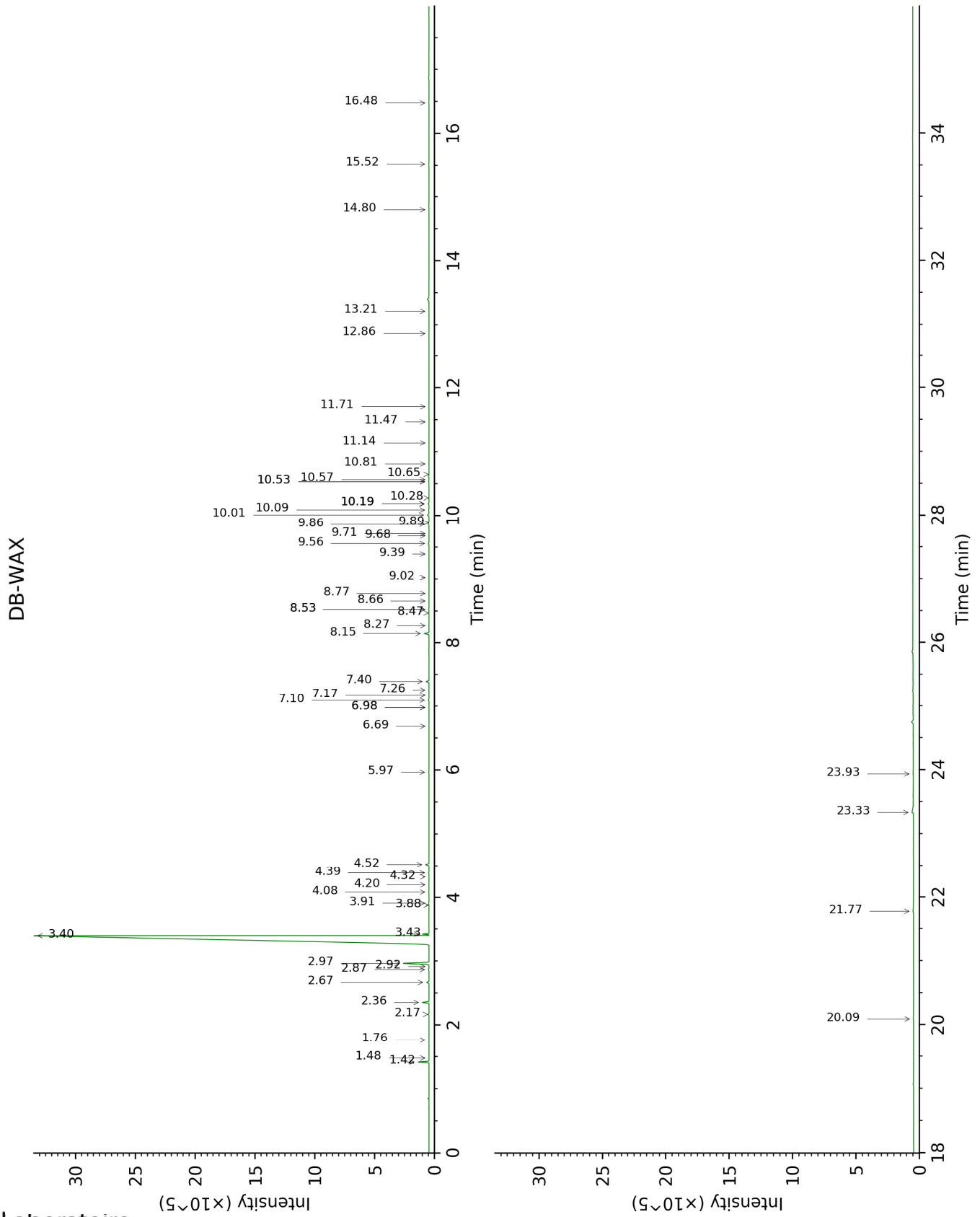
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
α-Thujene	3.12	924	0.01	1.48	1000	0.01
α-Pinene	3.19	929	0.52	1.42	991	0.52
Camphene	3.39	942	0.01	1.76	1026	tr
Sabinene	3.80*	969	0.44	2.36	1083	0.39
β-Pinene	3.80*	969	[0.44]	2.17	1065	0.05
Myrcene	4.14	991	1.87	2.97	1133	1.85
α-Phellandrene	4.29*	1002	0.25	2.87	1125	0.04
Pseudolimonene	4.29*	1002	[0.25]	2.92	1129	tr
Octanal	4.29*	1002	[0.25]	4.52	1252	0.21
Δ3-Carene	4.36	1006	0.17	2.67	1110	0.17
α-Terpinene	4.48	1013	tr			
(Z)-β-Ocimene	4.78*	1032	93.41	3.88	1204	0.01
1,8-Cineole	4.78*	1032	[93.41]	3.43	1169	0.26
Limonene	4.78*	1032	[93.41]	3.40	1166	92.95
para-Cymene	4.78*	1032	[93.41]	4.20	1228	0.01
(E)-β-Ocimene	5.04	1049	0.02	4.08	1219	0.02
γ-Terpinene	5.16	1056	0.03	3.91	1206	0.03
cis-Sabinene hydrate	5.28	1064	0.01	6.98*	1426	0.01
Octanol	5.44	1074	0.01	8.27	1523	0.02
Isoterpinolene	5.59	1083	0.01	4.32	1237	0.01
Terpinolene	5.62	1085	0.03	4.39	1242	0.03
Linalool	5.85	1100	0.31	8.15	1513	0.32
Nonanal	5.91	1103	0.04	5.97	1353	0.04
trans-para-Mentha-2,8-dien-1-ol	6.12	1117	0.01	9.02	1581	0.01
cis-Limonene oxide	6.34	1131	0.01			
trans-Limonene oxide	6.38	1134	0.01	6.69	1405	0.01
Citronellal	6.67	1152	0.05	7.10	1435	0.05
Terpinen-4-ol	6.98	1173	0.01	8.66	1553	0.01
α-Terpineol	7.20	1188	0.04	9.86	1648	0.06
Decanal	7.49	1206	0.20	7.40	1457	0.20
Octyl acetate	7.63	1216	0.01	7.17	1441	0.01
trans-Carveol	7.69	1220	0.01	11.47	1782	0.01
Nerol	7.86	1232	0.01	11.14	1754	0.01
Neral	7.98	1240	0.05	9.56	1623	0.05
Geraniol	8.34	1264	0.01	11.71	1802	0.01
Perillaldehyde	8.38	1267	0.01	10.81	1726	0.01
Geranial	8.44	1271	0.06	10.19*	1674	0.08
Limonen-10-ol	8.71	1290	0.01	13.21	1936	0.01
Undecanal	9.00	1304	0.01	8.77	1562	0.01
α-Cubebene	9.58	1345	0.01	6.98*	1426	[0.01]
Neryl acetate	9.84	1363	0.01	10.28	1682	0.01
α-Copaene	9.93	1370	0.02	7.26	1447	0.02
Geranyl acetate	10.11	1383	0.01	10.65	1712	0.01
β-Elemene	10.18	1388	0.01	8.52*	1542	0.03
Dodecanal	10.44	1407	0.04	10.09	1666	0.04
β-Caryophyllene	10.50	1412	0.02	8.52*	1542	[0.03]
β-Copaene	10.65	1422	0.02	8.47	1538	0.02



α-Humulene	10.96	1446	0.01	9.39	1610	0.01
(E)-β-Farnesene	11.11	1457	0.01	9.68	1633	0.01
γ-Murolene	11.28	1470	0.01	9.71	1636	0.01
Germacrene D	11.34	1474	0.02	9.89	1650	0.02
Valencene	11.51	1487	0.12	10.01	1660	0.12
Bicyclogermacrene	11.55	1490	0.01	10.19*	1674	[0.08]
α-Murolene	11.65	1497	0.01	10.19*	1674	[0.08]
γ-Cadinene	11.80	1510	0.02	10.53*†	1702	0.05
Zonarene	11.93*	1519	0.03	10.53*†	1702	[0.05]
δ-Cadinene	11.93*	1519	[0.03]	10.57†	1705	[0.05]
Caryophyllene oxide	12.62	1574	0.01	12.86	1904	0.01
β-Sinensal	14.09	1694	0.03	15.52	2158	0.03
α-Sinensal	14.74	1751	0.02	16.48	2256	0.02
Myristic acid	14.92	1767	0.04	20.09	2661	0.05
Hexadecanal	15.36	1805	0.01	14.80	2086	0.01
Palmitic acid	17.10	1966	0.09	21.78	2871	0.10
Linoleic acid	18.79	2133	0.05	23.93	3162	0.05
Oleic acid	18.85	2140	0.03			
cis-Vaccenic acid?	18.90	2145	0.05			
Stearic acid	19.12	2167	0.22	23.33	3079	0.36
Tetramethoxyflavone isomer	27.18	3134	0.03			
Tangeretin	27.21	3137	0.01			
3,3',4',5,6,7,8-Heptamethoxyflavone	29.32	3315	0.06			
Nobiletin	29.38	3318	0.02			
<b>Total identified</b>		<b>98.69%</b>			<b>98.44%</b>	
<b>Total reported</b>		<b>98.69%</b>			<b>98.44%</b>	

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

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

†: Peaks apexes were resolved, but peaks overlapped and were summed for analysis

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