

**Date :** March 13, 2023

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 23C07-PTH01

**Customer identification :** Lemon Steam Distilled - Argentina - LI0109R

**Type :** Essential oil

**Source :** *Citrus x limon* ct. Distilled

**Customer :** Plant Therapy

**ANALYSIS**

**Method:** PC-MAT-014  - 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 2014-005

**Analysis date :** March 09, 2023

Checked and approved by :

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Alexis St-Gelais, Ph. D., Chimiste 2013-174

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Clear liquid

**Refractive index:**  $1.4737 \pm 0.0003$  (20 °C; method PC-MAT-016)

*CONCLUSION*

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

## ANALYSIS SUMMARY – CONSOLIDATED CONTENTS

New readers of similar reports are encouraged to read table footnotes at least once.

Identification	%	Class
Octane	0.01	Alkane
Nonane	tr	Alkane
Heptanal	tr	Aliphatic aldehyde
Tricyclene	0.01	Monoterpene
$\alpha$ -Thujene	0.36	Monoterpene
$\alpha$ -Pinene	1.72	Monoterpene
Camphene	0.06	Monoterpene
$\beta$ -Pinene	11.15	Monoterpene
Sabinene	1.97	Monoterpene
Myrcene	1.45	Monoterpene
$\alpha$ -Phellandrene	0.03	Monoterpene
Octanal	0.07	Aliphatic aldehyde
$\alpha$ -Terpinene	0.16	Monoterpene
para-Cymene	0.67	Monoterpene
$\beta$ -Phellandrene	0.31	Monoterpene
Limonene	68.57	Monoterpene
(Z)- $\beta$ -Ocimene	0.05	Monoterpene
(E)- $\beta$ -Ocimene	0.10	Monoterpene
$\gamma$ -Terpinene	7.71	Monoterpene
cis-Sabinene hydrate	0.05	Monoterpenic alcohol
Octanol	0.01	Aliphatic alcohol
Terpinolene	0.35	Monoterpene
trans-Sabinene hydrate	0.05	Monoterpenic alcohol
Linalool	0.11	Monoterpenic alcohol
Nonanal	0.09	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.03	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.01	Monoterpenic alcohol
trans-Limonene oxide	0.02	Monoterpenic ether
Camphor	0.01	Monoterpenic ketone
Epoxyterpinolene	0.01	Monoterpenic ether
Citronellal	0.06	Monoterpenic aldehyde
Borneol	0.03	Monoterpenic alcohol
Terpinen-4-ol	0.07	Monoterpenic alcohol
Isogeranial	0.01	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.27	Monoterpenic alcohol
trans-Isopiperitenol	0.01	Monoterpenic alcohol
Decanal	0.04	Aliphatic aldehyde
trans-Carveol	0.01	Monoterpenic alcohol
2,3-Epoxyneral?	0.01	Monoterpenic aldehyde
Nerol	0.05	Monoterpenic alcohol
2,3-Epoxygeranial?	0.02	Monoterpenic aldehyde
Neral	0.80	Monoterpenic aldehyde
Geraniol	0.04	Monoterpenic alcohol
trans-Ascaridole glycol	0.01	Monoterpenic alcohol

Geranial	1.22	Monoterpenic aldehyde
Undecanal	0.02	Aliphatic aldehyde
Citronellyl acetate	0.02	Monoterpenic ester
Neryl acetate	0.36	Monoterpenic ester
Geranyl acetate	0.17	Monoterpenic ester
Dodecanal	0.01	Aliphatic aldehyde
<i>cis</i> - $\alpha$ -Bergamotene	0.02	Sesquiterpene
$\beta$ -Caryophyllene	0.16	Sesquiterpene
$\alpha$ -Santalene	0.01	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.32	Sesquiterpene
$\alpha$ -Humulene	0.02	Sesquiterpene
$\beta$ -Santalene	0.01	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.04	Sesquiterpene
Germacrene D	0.01	Sesquiterpene
Geranyl propionate	0.01	Monoterpenic ester
<i>trans</i> - $\beta$ -Bergamotene	0.03	Sesquiterpene
Valencene	0.03	Sesquiterpene
Bicyclogermacrene	0.04	Sesquiterpene
( <i>Z</i> )- $\alpha$ -Bisabolene	0.04	Sesquiterpene
$\beta$ -Bisabolene	0.43	Sesquiterpene
( <i>E</i> )- $\alpha$ -Bisabolene	0.02	Sesquiterpene
Spathulenol	0.03	Sesquiterpenic alcohol
Caryophyllene oxide	0.01	Sesquiterpenic ether
Unknown	0.02	Oxygenated sesquiterpene
Unknown	0.02	Oxygenated sesquiterpene
$\alpha$ -Bisabolol	0.02	Sesquiterpenic alcohol
<b>Consolidated total</b>	<b>99.69%</b>	

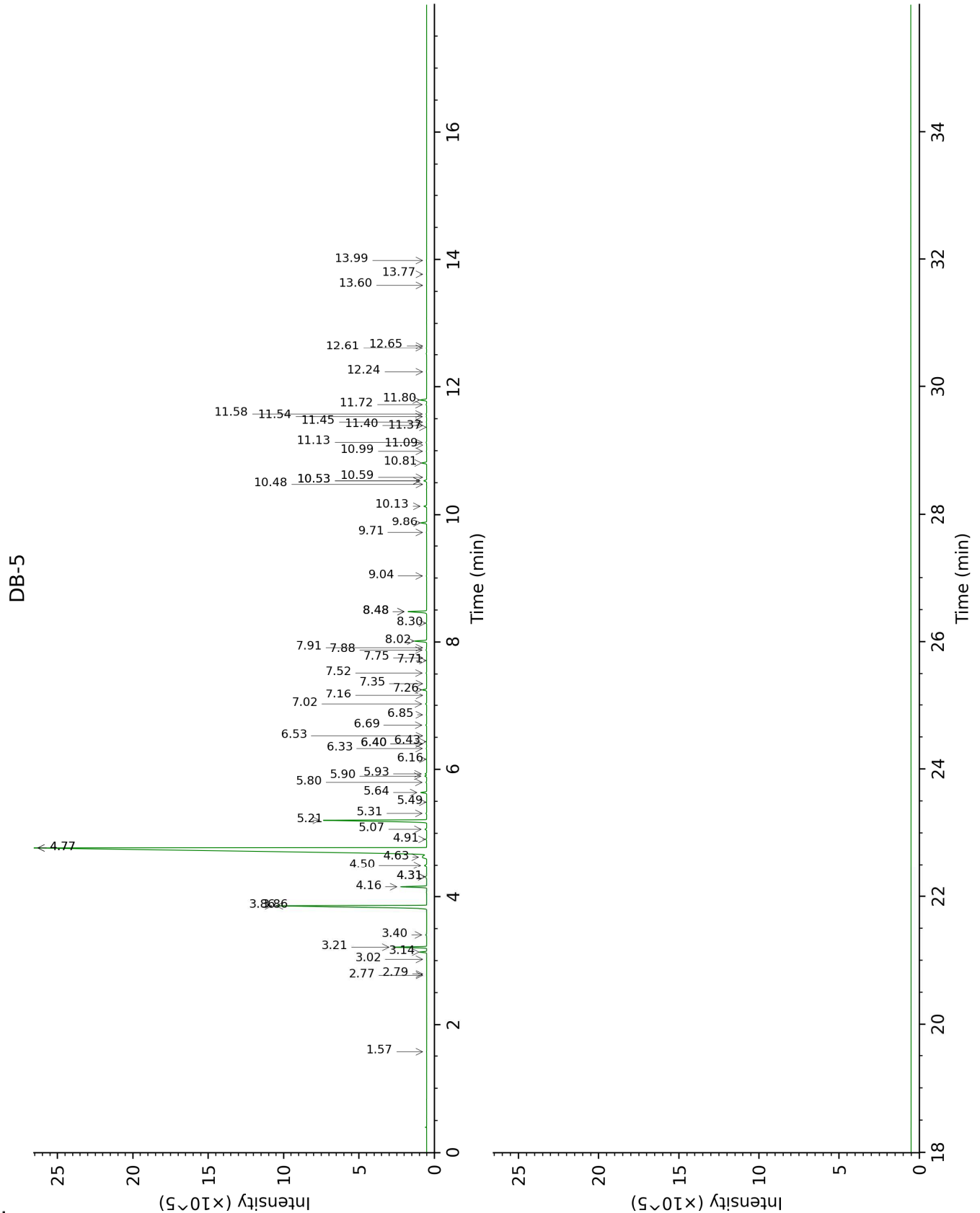
tr: The compound has been detected below 0.005% of total signal.

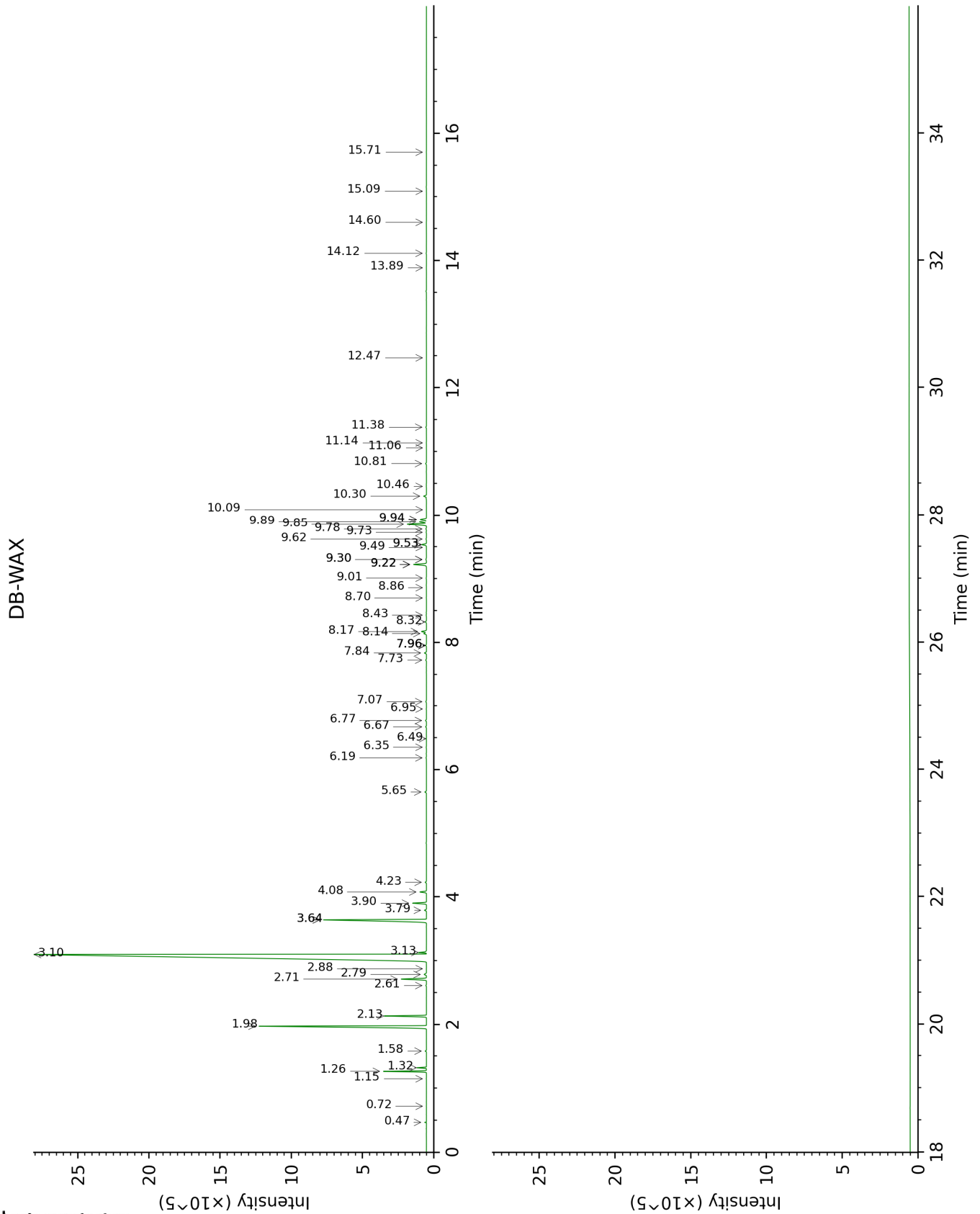
Note: no correction factor was applied

**About "consolidated" data:** The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm is set to prioritize data from the most standard DB-5 column, and smallest values so as to avoid overestimating individual content. This process is semi-automatic. Advanced users are invited to consult the "Full analysis data" table after the chromatograms in this report to access the full untreated data and perform their own calculations if needed.

**Unknowns:** Unknown compounds' mass spectral data is presented in the "Full analysis data" table. The occurrence of unknown compounds is to be expected in many samples, and does not denote particular problems unless noted otherwise in the conclusion.

This page was intentionally left blank. The following pages present the complete data of the analysis.





FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Octane	1.57	803	0.01	0.47	785	0.03
Nonane	2.77	902	tr	0.72	894	tr
Heptanal	2.79	904	tr	2.88	1148	tr
Tricyclene	3.02	919	0.01	1.15	972	0.01
$\alpha$ -Thujene	3.14	926	0.36	1.32	1000	0.36
$\alpha$ -Pinene	3.21	931	1.72	1.26	992	1.72
Camphene	3.40	944	0.06	1.58	1027	0.06
$\beta$ -Pinene	3.86*	974	13.14	1.98	1068	11.15
Sabinene	3.86*	974	[13.14]	2.14	1085	1.97
Myrcene	4.16	993	1.45	2.71	1135	1.46
$\alpha$ -Phellandrene	4.31*	1004	0.10	2.61	1127	0.03
Octanal	4.31*	1004	[0.10]	4.23	1256	0.07
$\alpha$ -Terpinene	4.50	1015	0.16	2.78	1141	0.16
para-Cymene	4.63	1023	0.67	3.90	1231	0.73
$\beta$ -Phellandrene	4.77*	1032	68.95	3.13	1169	0.31
Limonene	4.77*	1032	[68.95]	3.10	1167	68.57
(Z)- $\beta$ -Ocimene	4.91	1041	0.05	3.64*	1211	7.76
(E)- $\beta$ -Ocimene	5.06	1051	0.10	3.79	1222	0.11
$\gamma$ -Terpinene	5.21	1059	7.71	3.64*	1211	[7.76]
<i>cis</i> -Sabinene hydrate	5.31	1066	0.05	6.67	1430	0.05
Octanol	5.49	1077	0.01	7.96*	1528	0.05
Terpinolene	5.64	1086	0.35	4.08	1244	0.35
<i>trans</i> -Sabinene hydrate	5.80	1096	0.05	7.73	1510	0.05
Linalool	5.90	1102	0.11	7.84	1518	0.11
Nonanal	5.93	1105	0.09	5.65	1355	0.09
<i>trans</i> -para-Mentha-2,8-dien-1-ol	6.16	1119	0.01	8.70	1586	0.02
<i>cis</i> -Limonene oxide	6.33	1130	0.03	6.19	1394	0.03
<i>cis</i> -para-Mentha-2,8-dien-1-ol	6.40*	1135	0.03	9.22*	1628	0.82
<i>trans</i> -Limonene oxide	6.40*	1135	[0.03]	6.35	1406	0.02
Camphor	6.43	1137	0.01	6.95	1451	0.01
Epoxyterpinolene	6.53	1143	0.01	6.49	1416	0.01
Citronellal	6.69	1153	0.06	6.77	1438	0.05
Borneol	6.85	1163	0.03	9.53*	1653	0.28
Terpinen-4-ol	7.02	1174	0.07	8.32	1556	0.07
Isogeranial	7.16	1183	0.01	7.96*	1528	[0.05]
$\alpha$ -Terpineol	7.26	1189	0.27	9.53*	1653	[0.28]
<i>trans</i> -Isopiperitenol	7.35	1195	0.01	10.09	1699	0.01
Decanal	7.52	1206	0.04	7.06	1460	0.04
<i>trans</i> -Carveol	7.71	1219	0.01	11.14	1788	0.01
2,3-Epoxyneral?	7.76	1222	0.01			



Nerol	7.88	1230	0.05	10.81	1761	0.06
2,3-Epoxygeranial?	7.91	1232	0.02			
Neral	8.02	1239	0.80	9.22*	1628	[0.82]
Geraniol	8.30	1258	0.04	11.38	1810	0.04
<i>trans</i> -Ascaridole glycol	8.48*	1270	1.24	13.89	2040	0.01
Geranial	8.48*	1270	[1.24]	9.85	1680	1.22
Undecanal	9.04	1307	0.02	8.43	1565	0.02
Citronellyl acetate	9.72	1355	0.02	9.22*	1628	[0.82]
Neryl acetate	9.86	1366	0.36	9.94*	1686	0.40
Geranyl acetate	10.14	1385	0.17	10.30	1717	0.17
Dodecanal	10.48	1409	0.01	9.73	1669	0.02
<i>cis</i> - $\alpha$ -Bergamotene	10.53*	1413	0.20	7.96*	1528	[0.05]
$\beta$ -Caryophyllene	10.53*	1413	[0.20]	8.14†	1542	0.48
$\alpha$ -Santalene	10.59	1417	0.01	7.96*	1528	[0.05]
<i>trans</i> - $\alpha$ -Bergamotene	10.81	1434	0.32	8.17†	1545	[0.48]
$\alpha$ -Humulene	10.99	1447	0.02	9.01	1611	0.02
$\beta$ -Santalene	11.09	1454	0.01	8.86	1598	0.01
( <i>E</i> )- $\beta$ -Farnesene	11.13	1458	0.04	9.30*	1634	0.05
Germacrene D	11.37	1475	0.01	9.49	1650	0.01
Geranyl propionate	11.40	1477	0.01	11.06	1782	0.01
<i>trans</i> - $\beta$ -Bergamotene	11.45	1481	0.03	9.30*	1634	[0.05]
Valencene	11.54	1488	0.03	9.62	1660	0.03
Bicyclogermacrene	11.58	1491	0.04	9.78	1674	0.04
( <i>Z</i> )- $\alpha$ -Bisabolene	11.72	1502	0.04	9.94*	1686	[0.40]
$\beta$ -Bisabolene	11.80	1507	0.43	9.89	1683	0.43
( <i>E</i> )- $\alpha$ -Bisabolene	12.24	1542	0.02	10.46	1730	0.01
Spathulenol	12.61	1571	0.03	14.12	2062	0.02
Caryophyllene oxide	12.65	1574	0.01	12.47	1907	0.01
Unknown [m/z 94, 43 (89), 41 (67), 122 (46), 69 (41)...222]	13.60	1651	0.02	14.60	2109	0.01
Unknown [m/z 69, 95 (100), 41 (89), 109 (68), 67 (61)...222]	13.77	1665	0.02	15.71	2222	0.01
$\alpha$ -Bisabolol	13.99	1683	0.02	15.09	2158	0.01
<b>Total identified</b>		<b>99.76%</b>			<b>99.62%</b>	
<b>Total reported</b>		<b>99.80%</b>			<b>99.64%</b>	

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

[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated 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