

**Date :** April 27, 2023

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 23D14-NPA01


**Customer identification :** NPS00050-Citrus limon - Argentina- lo#NP0016

**Type :** Essential oil

**Source :** *Citrus x limon*

**Customer :** Nature Packaged

**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 :** Amélie Simard, Analyste

**Analysis date :** April 24, 2023

Checked and approved by :

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

*Notes: This report is digitally signed, it is only considered valid if the digital signature is intact. The results only describe the samples that were submitted to the assays.*

*This report is an update from the first version issued on April 27, 2023, to format it for online publication.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Yellow liquid

**Refractive index:**  $1.4744 \pm 0.0003$  (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
Hexanal	tr	Aliphatic aldehyde
Octane	tr	Alkane
Tricyclene	0.01	Monoterpene
$\alpha$ -Thujene	0.40	Monoterpene
$\alpha$ -Pinene	1.83	Monoterpene
Camphene	0.07	Monoterpene
$\beta$ -Pinene	12.12	Monoterpene
Sabinene	2.07	Monoterpene
6-Methyl-5-hepten-2-one	0.02	Aliphatic ketone
Myrcene	1.45	Monoterpene
Pseudolimonene	0.01	Monoterpene
Octanal	0.09	Aliphatic aldehyde
$\alpha$ -Phellandrene	0.04	Monoterpene
$\Delta^3$ -Carene	0.01	Monoterpene
$\alpha$ -Terpinene	0.19	Monoterpene
para-Cymene	0.20	Monoterpene
Limonene	66.57	Monoterpene
1,8-Cineole	0.35	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.07	Monoterpene
(E)- $\beta$ -Ocimene	0.12	Monoterpene
$\gamma$ -Terpinene	8.24	Monoterpene
cis-Sabinene hydrate	0.06	Monoterpenic alcohol
Octanol	0.01	Aliphatic alcohol
Terpinolene	0.36	Monoterpene
trans-Sabinene hydrate	0.05	Monoterpenic alcohol
Linalool	0.10	Monoterpenic alcohol
Nonanal	0.12	Aliphatic aldehyde
trans-para-Mentha-2,8-dien-1-ol	0.01	Monoterpenic alcohol
cis-Limonene oxide	0.02	Monoterpenic ether
trans-Limonene oxide	0.01	Monoterpenic ether
Camphor	0.02	Monoterpenic ketone
Citronellal	0.08	Monoterpenic aldehyde
Borneol	0.02	Monoterpenic alcohol
Unknown	0.01	Unknown
Terpinen-4-ol	0.04	Monoterpenic alcohol
Isogeranial	0.01	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.22	Monoterpenic alcohol
Decanal	0.04	Aliphatic aldehyde
trans-Piperitol	tr	Monoterpenic alcohol
trans-Carveol	0.01	Monoterpenic alcohol
2,3-Epoxyneral?	0.01	Monoterpenic aldehyde
Nerol	0.04	Monoterpenic alcohol
2,3-Epoxygeranial?	0.02	Monoterpenic aldehyde
Neral	0.72	Monoterpenic aldehyde
Carvone	0.01	Monoterpenic ketone

Geraniol	0.03	Monoterpenic alcohol
Geranial	1.22	Monoterpenic aldehyde
Limonen-10-ol	0.02	Monoterpenic alcohol
Undecanal	0.03	Aliphatic aldehyde
Citronellyl acetate	0.03	Monoterpenic ester
Neryl acetate	0.45	Monoterpenic ester
Geranyl acetate	0.24	Monoterpenic ester
Dodecanal	0.02	Aliphatic aldehyde
<i>cis</i> - $\alpha$ -Bergamotene	0.04	Sesquiterpene
$\beta$ -Caryophyllene	0.18	Sesquiterpene
$\alpha$ -Santalene	0.02	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.36	Sesquiterpene
$\alpha$ -Humulene	0.02	Sesquiterpene
$\beta$ -Santalene	0.01	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.05	Sesquiterpene
Germacrene D	0.01	Sesquiterpene
<i>trans</i> - $\beta$ -Bergamotene	0.03	Sesquiterpene
Valencene	0.04	Sesquiterpene
Bicyclogermacrene	0.06	Sesquiterpene
( <i>Z</i> )- $\alpha$ -Bisabolene	0.06	Sesquiterpene
$\gamma$ -Cadinene	0.01	Sesquiterpene
$\beta$ -Bisabolene	0.53	Sesquiterpene
( <i>Z</i> )- $\gamma$ -Bisabolene	0.01	Sesquiterpene
( <i>E</i> )- $\alpha$ -Bisabolene	0.02	Sesquiterpene
Spathulenol	0.02	Sesquiterpenic alcohol
Unknown	0.03	Oxygenated sesquiterpene
Unknown	0.02	Oxygenated sesquiterpene
$\alpha$ -Bisabolol	0.03	Sesquiterpenic alcohol
Citropten	0.05	Furanocoumarin
Linoleic acid	0.04	Aliphatic acid
<b>Consolidated total</b>	<b>99.55%</b>	

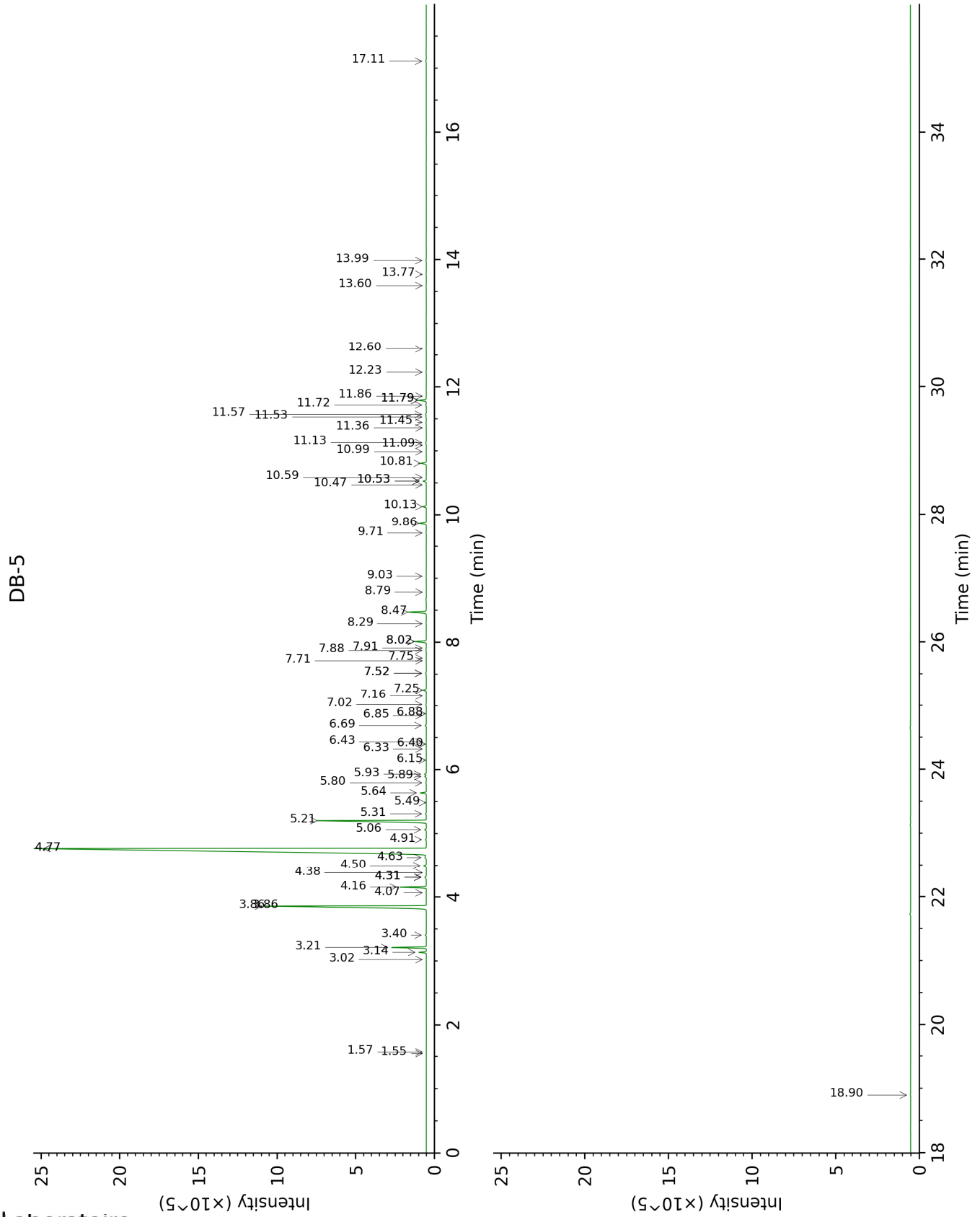
tr: The compound has been detected below 0.005% of total signal.

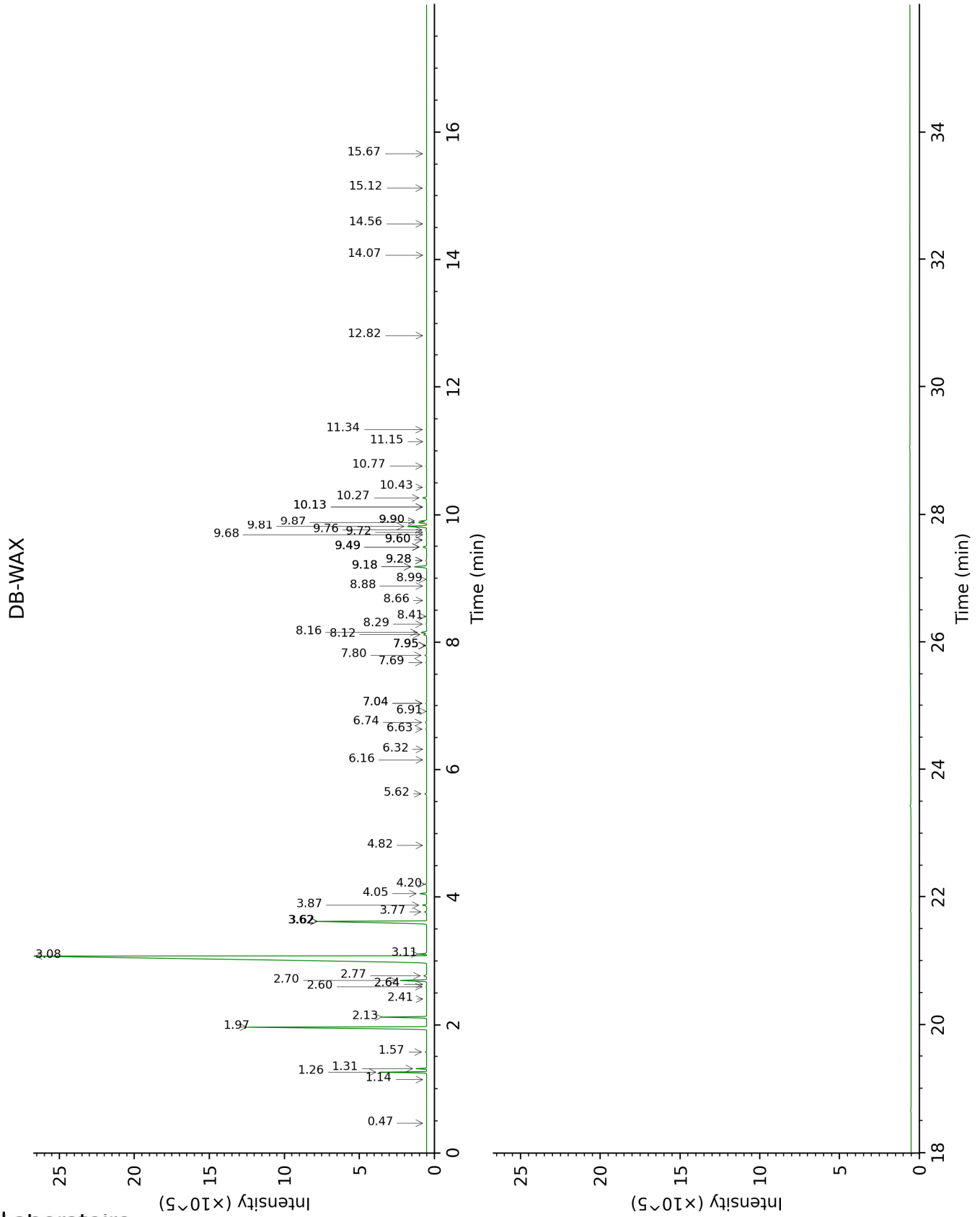
Note: no correction factor was applied

**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	%
Hexanal	1.55	800	tr			
Octane	1.57	804	tr	0.47	783	tr
Tricyclene	3.02	919	0.01	1.14	971	0.01
$\alpha$ -Thujene	3.14	926	0.40	1.31	1000	0.39
$\alpha$ -Pinene	3.21	931	1.83	1.26	991	1.83
Camphene	3.40	944	0.07	1.57	1026	0.06
$\beta$ -Pinene	3.86*	974	14.11	1.97	1068	12.12
Sabinene	3.86*	974	[14.11]	2.13	1084	2.07
6-Methyl-5-hepten-2-one	4.07	988	0.02	4.82	1302	0.02
Myrcene	4.16	993	1.45	2.70	1134	1.47
Pseudolimonene	4.31*	1004	0.14	2.64	1129	0.01
Octanal	4.31*	1004	[0.14]	4.20	1254	0.09
$\alpha$ -Phellandrene	4.31*	1004	[0.14]	2.60	1126	0.04
$\Delta$ 3-Carene	4.38	1008	0.01	2.41	1110	0.01
$\alpha$ -Terpinene	4.50	1015	0.19	2.77	1140	0.18
para-Cymene	4.63	1023	0.20	3.87	1229	0.22
Limonene	4.77*	1032	66.44	3.08	1165	66.57
1,8-Cineole	4.77*	1032	[66.44]	3.11	1168	0.35
(Z)- $\beta$ -Ocimene	4.91	1041	0.07	3.62*	1209	8.35
(E)- $\beta$ -Ocimene	5.06	1050	0.12	3.77	1221	0.11
$\gamma$ -Terpinene	5.20	1059	8.24	3.62*	1209	[8.35]
cis-Sabinene hydrate	5.31	1066	0.06	6.63	1427	0.05
Octanol	5.49	1077	0.01	7.95*	1527	0.08
Terpinolene	5.64	1086	0.36	4.05	1243	0.36
trans-Sabinene hydrate	5.80	1096	0.05	7.69	1507	0.04
Linalool	5.89	1102	0.10	7.80	1515	0.10
Nonanal	5.93	1105	0.12	5.62	1353	0.11
trans-para-Mentha-2,8-dien-1-ol	6.15	1119	0.01	8.66	1582	0.01
cis-Limonene oxide	6.32	1130	0.02	6.16	1392	0.01
trans-Limonene oxide	6.40	1135	0.01	6.32	1404	0.01
Camphor	6.43	1137	0.02	6.91	1448	0.01
Citronellal	6.69	1153	0.08	6.74	1435	0.07
Borneol	6.85	1163	0.02	9.49*	1650	0.22
Unknown [m/z 43, 109 (68), 67 (62), 81 (36), 41 (31), 137 (29), 79 (26)...]	6.88	1165	0.01	7.04*	1458	0.05
Terpinen-4-ol	7.02	1174	0.04	8.29	1554	0.04
Isogeranial	7.16	1183	0.01	7.95*	1527	[0.08]
$\alpha$ -Terpineol	7.25	1189	0.22	9.49*	1650	[0.22]
Decanal	7.52*	1206	0.06	7.04*	1458	[0.05]



<i>trans</i> -Piperitol	7.52*	1206	[0.06]	10.13*	1702	0.02
<i>trans</i> -Carveol	7.71	1219	0.01	11.15	1789	0.01
2,3-Epoxyneral?	7.76	1222	0.01			
Nerol	7.88	1230	0.04	10.77	1757	0.04
2,3-Epoxygeranial?	7.91	1232	0.02			
Neral	8.02*	1239	0.75	9.18*	1625	0.76
Carvone	8.02*	1239	[0.75]	9.72	1668	0.01
Geraniol	8.29	1258	0.03	11.34	1805	0.03
Geranial	8.48	1270	1.22	9.81	1676	1.19
Limonen-10-ol	8.79	1290	0.02	12.82	1939	0.01
Undecanal	9.03	1307	0.03	8.41	1563	0.03
Citronellyl acetate	9.71	1355	0.03	9.18*	1625	[0.76]
Neryl acetate	9.86	1365	0.45	9.90*	1684	0.48
Geranyl acetate	10.13	1384	0.24	10.27	1714	0.24
Dodecanal	10.47	1408	0.02	9.68	1666	0.01
<i>cis</i> - $\alpha$ -Bergamotene	10.53*	1413	0.22	7.95*	1527	[0.08]
$\beta$ -Caryophyllene	10.53*	1413	[0.22]	8.12†	1541	0.54
$\alpha$ -Santalene	10.59	1417	0.02	7.95*	1527	[0.08]
<i>trans</i> - $\alpha$ -Bergamotene	10.81	1434	0.36	8.16†	1543	[0.54]
$\alpha$ -Humulene	10.99	1447	0.02	8.99	1609	0.02
$\beta$ -Santalene	11.09	1455	0.01	8.88	1600	0.02
( <i>E</i> )- $\beta$ -Farnesene	11.13	1458	0.05	9.28*	1633	0.05
Germacrene D	11.36	1475	0.01	9.49*	1650	[0.22]
<i>trans</i> - $\beta$ -Bergamotene	11.45	1481	0.03	9.28*	1633	[0.05]
Valencene	11.53	1487	0.04	9.60*	1659	0.04
Bicyclogermacrene	11.57	1490	0.06	9.76	1672	0.06
( <i>Z</i> )- $\alpha$ -Bisabolene	11.72	1501	0.06	9.90*	1684	[0.48]
$\gamma$ -Cadinene	11.80*	1507	0.55	10.13*	1702	[0.02]
$\beta$ -Bisabolene	11.80*	1507	[0.55]	9.87	1681	0.53
( <i>Z</i> )- $\gamma$ -Bisabolene	11.86	1512	0.01	9.60*	1659	[0.04]
( <i>E</i> )- $\alpha$ -Bisabolene	12.23	1542	0.02	10.43	1728	0.03
Spathulenol	12.60	1570	0.02	14.07	2058	0.01
Unknown [m/z 94, 43 (89), 41 (67), 122 (46), 69 (41)...222]	13.60	1650	0.03	14.56	2106	0.02
Unknown [m/z 69, 95 (100), 41 (89), 109 (68), 67 (61)...222]	13.77	1665	0.02	15.67	2218	0.02
$\alpha$ -Bisabolol	13.99	1683	0.03	15.12	2162	0.03
Citropten	17.11	1962	0.05			
Linoleic acid	18.90	2139	0.04			
<b>Total identified</b>		<b>98.96%</b>			<b>99.18%</b>	
<b>Total reported</b>		<b>99.03%</b>			<b>99.22%</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

