

Date : May 04, 2021

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

**Internal code** : 21D20-ORA12


**Customer identification** : Marjoram - Egypt - 3 years - 605038

**Type** : Essential oil

**Source** : *Origanum majorana*

**Customer** : Organic Aromas Inc.

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** : Benoit Roger, Ph. D.

**Analysis date** : May 04, 2021

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4741 \pm 0.0003$  (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
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	0.01	Aliphatic aldehyde
2-Ethylfuran	0.01	Furan
Isoamyl alcohol	tr	Aliphatic alcohol
2-Methylbutanol	tr	Aliphatic alcohol
Methyl 2-methylbutyrate	0.02	Aliphatic ester
Octane	0.01	Alkane
(2E)-Hexenal	0.01	Aliphatic aldehyde
(3Z)-Hexenol	0.01	Aliphatic alcohol
Hashishene	0.01	Monoterpene
Tricyclene	tr	Monoterpene
$\alpha$ -Thujene	0.74	Monoterpene
$\alpha$ -Pinene	0.86	Monoterpene
Camphene	0.04	Monoterpene
$\beta$ -Pinene	0.49	Monoterpene
Sabinene	8.98	Monoterpene
3-Methyl-3-cyclohexenone	0.01	Aliphatic ketone
Octan-3-one	0.02	Aliphatic ketone
Myrcene	2.20	Monoterpene
Pseudolimonene	0.06	Monoterpene
$\alpha$ -Phellandrene	0.40	Monoterpene
$\alpha$ -Terpinene	8.19	Monoterpene
Carvomenthene	0.02	Aliphatic alcohol
para-Cymene	1.58	Monoterpene
$\beta$ -Phellandrene	2.14*	Monoterpene
1,8-Cineole	[2.14]*	Monoterpenic ether
Limonene	1.77	Monoterpene
(Z)- $\beta$ -Ocimene	0.02	Monoterpene
(E)- $\beta$ -Ocimene	0.03	Monoterpene
$\gamma$ -Terpinene	13.31	Monoterpene
cis-Sabinene hydrate	3.65	Monoterpenic alcohol
Terpinolene	3.05	Monoterpene
para-Cymenene	0.02	Monoterpene
trans-Sabinene hydrate	11.87	Monoterpenic alcohol
Unknown	0.02	Oxygenated monoterpene
Linalool	0.62	Monoterpenic alcohol
Unknown	0.03	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	1.64	Monoterpenic alcohol
$\alpha$ -Campholenal	0.04	Monoterpenic aldehyde
trans-Pinocarveol	0.07	Monoterpenic alcohol
trans-para-Menth-2-en-1-ol	0.93	Monoterpenic alcohol
Unknown	0.02	Unknown
1,4-Dimethyl-4-acetylcyclohexene	0.05	Monoterpenic ketone
Pinocarvone	0.02	Monoterpenic ketone
Borneol	0.05	Monoterpenic alcohol

δ-Terpineol	0.01	Monoterpenic alcohol
Terpinen-4-ol	23.11	Monoterpenic alcohol
Cryptone	0.02	Normonoterpenic ketone
para-Cymen-8-ol	0.05	Monoterpenic alcohol
α-Terpineol	3.60	Monoterpenic alcohol
cis-Piperitol	0.53	Monoterpenic alcohol
Methylchavicol	0.01	Phenylpropanoid
trans-Dihydrocarvone	0.16	Monoterpenic ketone
Unknown	0.03	Unknown
trans-Piperitol	0.47	Monoterpenic alcohol
trans-Carveol	0.03	Monoterpenic alcohol
Nerol	0.03	Monoterpenic alcohol
Citronellol	0.02	Monoterpenic alcohol
Unknown	0.02	Oxygenated monoterpene
Neral	0.04	Monoterpenic aldehyde
trans-Sabinene hydrate acetate	0.82	Monoterpenic ester
Linalyl acetate	1.04	Monoterpenic ester
Geraniol	0.06	Monoterpenic alcohol
trans-Ascaridole glycol	0.07	Monoterpenic alcohol
Geranial	0.01	Monoterpenic aldehyde
Citronellyl formate	0.02	Monoterpenic ester
Bornyl acetate	0.07	Monoterpenic ester
Terpinen-4-yl acetate	0.24	Monoterpenic ester
Thymol	0.02	Monoterpenic alcohol
Unknown	0.06	Monoterpenic alcohol
Unknown	0.07	Monoterpenic alcohol
Bicycloelemene	0.05	Sesquiterpene
Eugenol	0.04	Phenylpropanoid
Neryl acetate	0.01	Monoterpenic ester
Geranyl acetate	0.05	Monoterpenic ester
β-Elemene	0.02	Sesquiterpene
β-Caryophyllene	2.84	Sesquiterpene
Aromadendrene	0.03	Sesquiterpene
trans-α-Bergamotene	0.02	Sesquiterpene
α-Humulene	0.14	Sesquiterpene
allo-Aromadendrene	0.03	Sesquiterpene
Germacrene D	0.01	Sesquiterpene
Bicyclogermacrene	1.69	Sesquiterpene
Viridiflorene	0.07	Sesquiterpene
γ-Cadinene	0.06	Sesquiterpene
δ-Cadinene	0.03	Sesquiterpene
Isocaryophyllene epoxide B	0.05	Sesquiterpenic ether
Spathulenol	0.12	Sesquiterpenic alcohol
Caryophyllene oxide	0.08	Sesquiterpenic ether
Caryophyllene oxide isomer	0.01	Sesquiterpenic ether
Viridiflorol	0.02	Sesquiterpenic alcohol
10-epi-γ-Eudesmol	0.02	Sesquiterpenic alcohol
Isospathulenol	0.07	Sesquiterpenic alcohol
τ-Cadinol	0.02	Sesquiterpenic alcohol
Unknown	0.02	Diterpene
<b>Consolidated total</b>	<b>99.10%</b>	

\*: Individual compounds concentration could not be found due to overlapping coelutions on columns considered

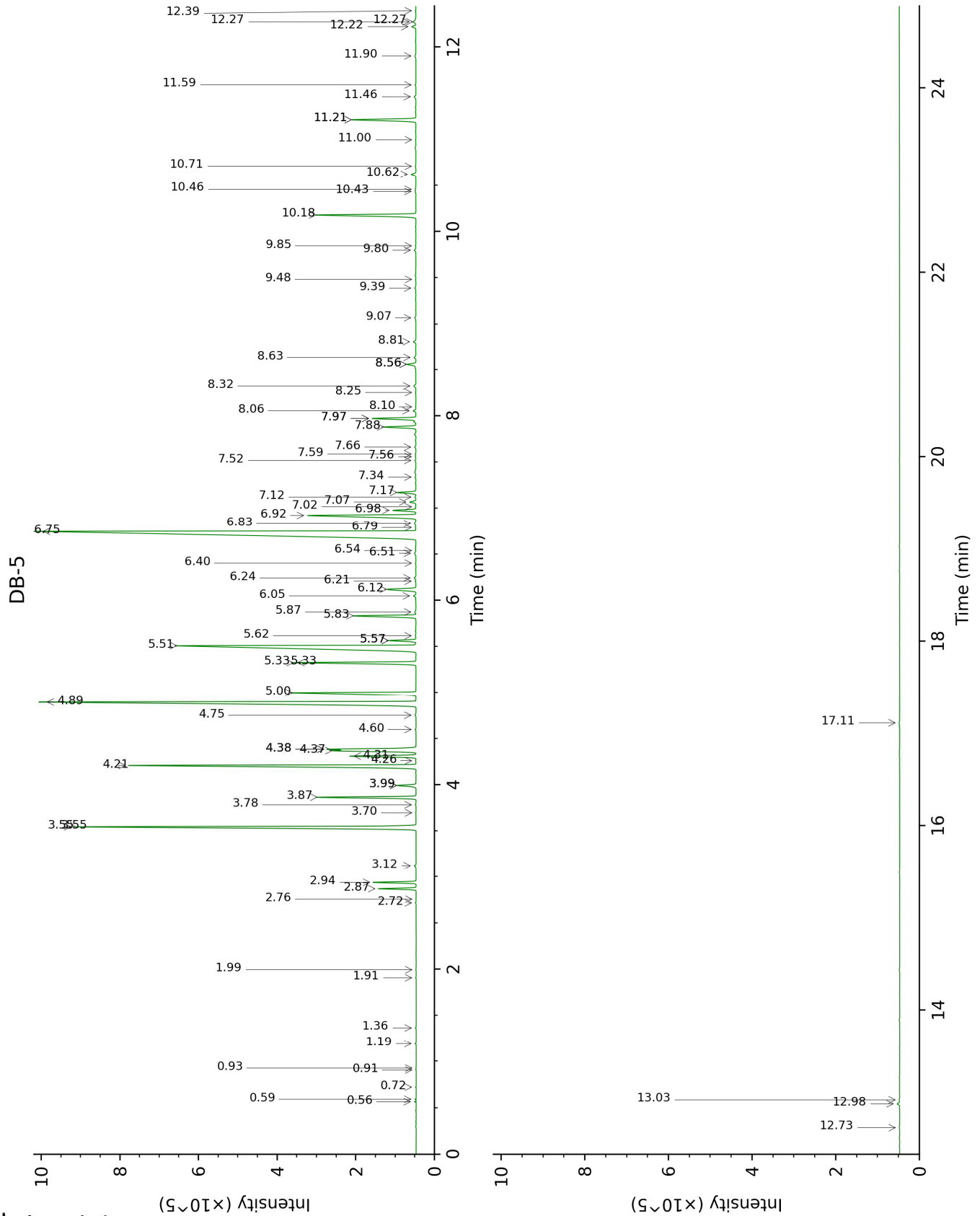
[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated total  
tr: The compound has been detected below 0.005% of total signal.

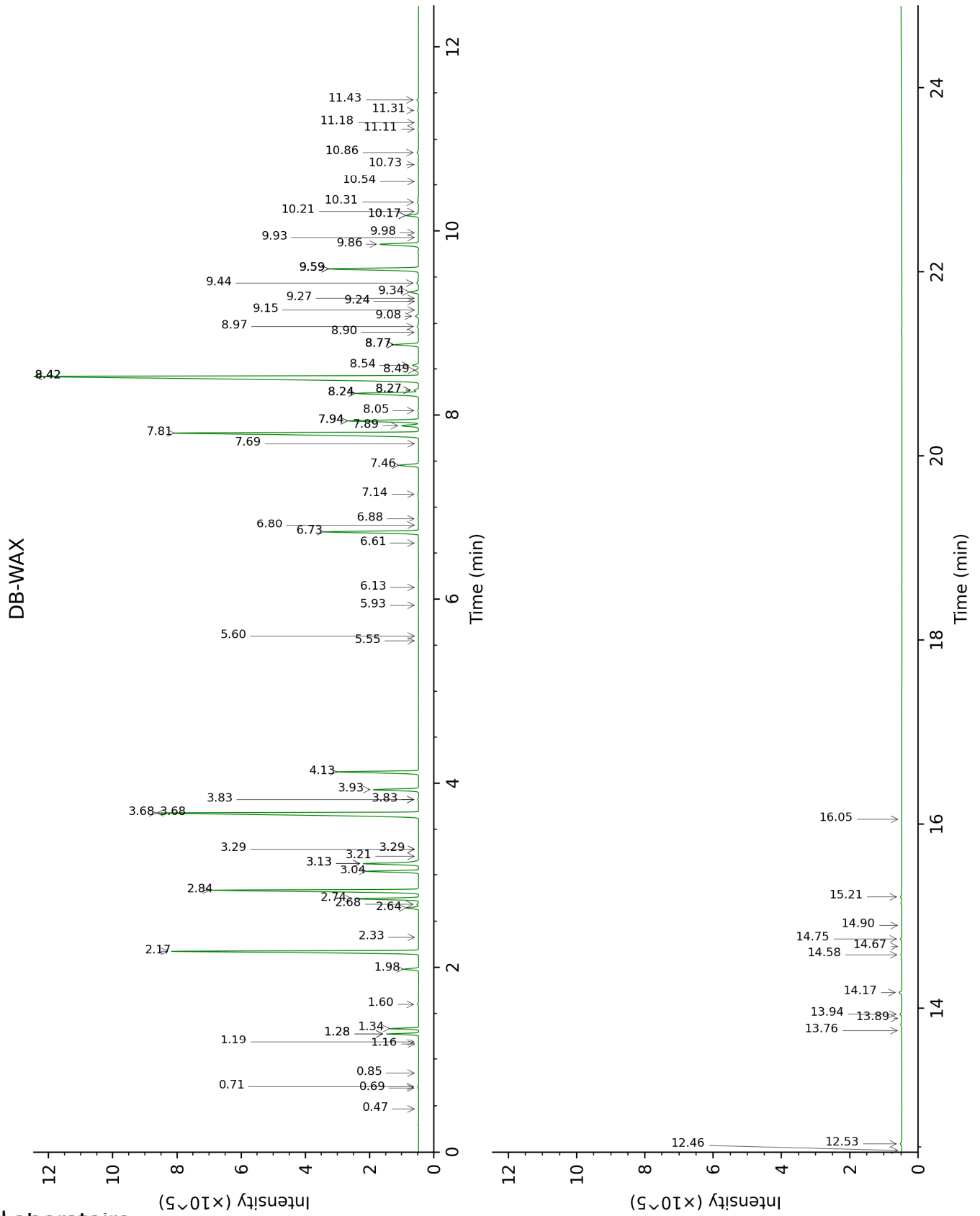
Note: no correction factor was applied

**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	%
Isovaleral	0.56	639	0.01	0.71	886	0.02
2-Methylbutyral	0.59	650	0.01	0.69	880	0.01
2-Ethylfuran	0.72	702	0.01	0.85	918	0.01
Isoamyl alcohol	0.91	732	tr	3.29*	1177	0.01
2-Methylbutanol	0.93	735	tr	3.29*	1177	[0.01]
Methyl 2-methylbutyrate	1.19	775	0.02	1.19	976	0.01
Octane	1.36	801	0.01	0.47	784	0.01
(2E)-Hexenal	1.91	850	0.01	3.21	1171	0.01
(3Z)-Hexenol	1.99	857	0.01	5.60	1347	0.01
Hashishene	2.72	917	0.01	1.28*	992	0.87
Tricyclene	2.76	919	tr	1.16	972	tr
$\alpha$ -Thujene	2.87	927	0.74	1.34	1001	0.74
$\alpha$ -Pinene	2.94	932	0.86	1.28*	992	[0.87]
Camphene	3.12	944	0.04	1.60	1027	0.04
$\beta$ -Pinene	3.55*	973	9.52	1.98	1066	0.49
Sabinene	3.55*	973	[9.52]	2.18	1085	8.98
3-Methyl-3-cyclohexenone	3.70	983	0.01	5.94	1371	0.02
Octan-3-one	3.78	989	0.02	3.82*	1219	0.04
Myrcene	3.87	994	2.20	2.74	1134	2.16
Pseudolimonene	3.99*	1003	0.46	2.68	1129	0.06
$\alpha$ -Phellandrene	3.99*	1003	[0.46]	2.64	1126	0.40
$\alpha$ -Terpinene	4.21	1017	8.19	2.84	1141	8.15
Carvomenthene	4.26	1020	0.02	2.33	1101	0.01
para-Cymene	4.31	1023	1.58	3.93	1227	1.58
$\beta$ -Phellandrene	4.37†	1027	3.91	3.13*	1165	2.12
1,8-Cineole	4.38*†	1028	[3.91]	3.13*	1165	[2.12]
Limonene	4.38*†	1028	[3.91]	3.04	1158	1.77
(Z)- $\beta$ -Ocimene	4.60	1041	0.02	3.68*	1208	13.34
(E)- $\beta$ -Ocimene	4.75	1051	0.03	3.82*	1219	[0.04]
$\gamma$ -Terpinene	4.90	1060	13.31	3.68*	1208	[13.34]
cis-Sabinene hydrate	5.00	1067	3.65	6.73	1430	3.69
Terpinolene	5.33*	1088	3.08	4.13	1241	3.05
para-Cymenene	5.33*	1088	[3.08]	6.13	1385	0.02
trans-Sabinene hydrate	5.51	1099	11.87	7.81	1511	11.99
Unknown [m/z 95, 150 (45), 110 (35), 107 (23), 109 (21)]	5.57*	1103	0.62	5.55	1343	0.02
Linalool	5.57*	1103	[0.62]	7.89	1517	0.62
Unknown [m/z 119, 109 (94), 43 (61), 95 (56), 91 (48), 77 (32), 152 (32), 137 (31), 134 (24)]	5.62	1106	0.03	8.27*	1547	0.16

<i>cis</i> -para-Menth-2-en-1-ol	5.83	1120	1.64	7.94*	1521	2.73
$\alpha$ -Campholenal	5.87	1122	0.04	6.80	1435	0.02
<i>trans</i> -Pinocarveol	6.05	1134	0.07	8.97	1601	0.06
<i>trans</i> -para-Menth-2-en-1-ol	6.12	1138	0.93	8.77*	1586	0.96
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.21	1144	0.02	6.61	1420	0.02
1,4-Dimethyl-4-acetylcyclohexene	6.24	1146	0.05	7.14	1461	0.03
Pinocarpone	6.40	1156	0.02	7.69	1502	0.01
Borneol	6.51	1163	0.05	9.59*	1652	3.72
$\delta$ -Terpineol	6.54	1165	0.01	9.24	1624	0.01
Terpinen-4-ol	6.75	1179	23.11	8.42*	1559	23.42
Cryptone	6.79	1181	0.02	8.90	1596	0.03
para-Cymen-8-ol	6.83	1184	0.05	11.31	1797	0.04
$\alpha$ -Terpineol	6.92	1190	3.60	9.59*	1652	[3.72]
<i>cis</i> -Piperitol	6.98	1194	0.53	9.34	1632	0.35
Methylchavicol	7.02	1196	0.01	9.15	1616	0.02
<i>trans</i> -Dihydrocarvone	7.07	1199	0.16	8.49	1564	0.15
Unknown [m/z 95, 93 (32), 121 (24), 79 (22), 91 (21), 105 (16)... 154 (2)]	7.12	1203	0.03	10.73	1747	0.03
<i>trans</i> -Piperitol	7.17	1206	0.47	10.17*	1700	0.50
<i>trans</i> -Carveol	7.34	1217	0.03	11.18	1786	0.02
Nerol	7.52	1229	0.03	10.86	1758	0.07
Citronellol	7.56	1232	0.02	10.54	1731	0.03
Unknown [m/z 137, 152 (28), 43 (25), 91 (24), 109 (23), 119 (19)]	7.59	1234	0.02	11.11	1780	0.02
Neral	7.66	1239	0.04	9.27	1626	0.02
<i>trans</i> -Sabinene hydrate acetate	7.88	1254	0.82	7.46	1484	0.78
Linalyl acetate	7.97*	1260	1.10	7.94*	1521	[2.73]
Geraniol	7.97*	1260	[1.10]	11.43	1807	0.06
<i>trans</i> -Ascaridole glycol	8.06	1265	0.07	13.94	2038	0.07
Geranial	8.10	1268	0.01	9.93	1680	0.01
Citronellyl formate	8.25	1279	0.02	8.77*	1586	[0.96]
Bornyl acetate	8.32	1283	0.07	8.05	1530	0.04
Terpinen-4-yl acetate	8.56*	1299	0.27	8.54	1568	0.24
Thymol	8.56*	1299	[0.27]	14.90	2132	0.02
Unknown analog	8.63	1304	0.06			
Unknown [m/z 97, 112 (92), 83 (62),	8.81	1317	0.07	14.75	2118	0.06

43 (44), 41 (25)... 170? (4)]						
Bicycloelemene	9.07	1335	0.05	6.88	1441	0.03
Eugenol	9.39	1358	0.04	14.58	2101	0.04
Neryl acetate	9.48	1364	0.01	9.98	1684	0.03
Geranyl acetate	9.80	1387	0.05	10.31	1712	0.05
β-Elemene	9.84	1390	0.02	8.24*	1544	2.83
β-Caryophyllene	10.18	1414	2.84	8.24*	1544	[2.83]
Aromadendrene	10.43	1433	0.03	8.42*	1559	[23.42]
<i>trans</i> -α- Bergamotene	10.46	1435	0.02	8.27*	1547	[0.16]
α-Humulene	10.62	1447	0.14	9.08	1610	0.13
allo- Aromadendrene	10.71	1454	0.03	8.77*	1586	[0.96]
Germacrene D	11.00	1475	0.01	9.59*	1652	[3.72]
Bicyclogermacrene	11.22*	1492	1.78	9.86	1674	1.69
Viridiflorene	11.22*	1492	[1.78]	9.44	1640	0.07
γ-Cadinene	11.46	1510	0.06	10.17*	1700	[0.50]
δ-Cadinene	11.59	1520	0.03	10.21	1703	0.03
Isocaryophyllene epoxide B	11.90	1545	0.05			
Spathulenol	12.22	1570	0.12	14.17	2061	0.12
Caryophyllene oxide	12.27*	1574	0.12	12.53	1906	0.08
Caryophyllene oxide isomer	12.27*	1574	[0.12]	12.46	1900	0.01
Viridiflorol	12.39	1584	0.02	13.76	2021	0.03
10-epi-γ-Eudesmol	12.73	1610	0.02	13.89	2034	0.02
Isospathulenol	12.98	1631	0.07	15.21	2164	0.06
τ-Cadinol	13.03	1635	0.02	14.67	2110	0.02
Unknown [m/z 257, 258 (20), 91 (19), 272 (18)]	17.11	1999	0.02	16.05	2251	0.01
<b>Total identified</b>		<b>98.96%</b>			<b>99.03%</b>	
<b>Total reported</b>		<b>99.21%</b>			<b>99.18%</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