

**Date :** March 18, 2021

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 21C11-PTH02


**Customer identification :** Spearmint - USA - S30109204R

**Type :** Essential oil

**Source :** *Mentha spicata*

**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

**Analysis date :** March 18, 2021

Checked and approved by :

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

*Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia. 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.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4891 \pm 0.0003$  (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
Isobutyral	0.01	Aliphatic aldehyde
Isovaleral	0.04	Aliphatic aldehyde
2-Methylbutyral	0.02	Aliphatic aldehyde
2-Ethylfuran	0.01	Furan
Isoamyl alcohol	0.01	Aliphatic alcohol
2-Methylbutanol	0.01	Aliphatic alcohol
Methyl 2-methylbutyrate	0.01	Aliphatic ester
Hexanal	0.01	Aliphatic aldehyde
(2E)-Hexenal	0.01	Aliphatic aldehyde
Ethyl 2-methylbutyrate	0.01	Aliphatic ester
(3Z)-Hexenol	0.02	Aliphatic alcohol
(2E)-Hexenol	0.01	Aliphatic alcohol
Hexanol	0.01	Aliphatic alcohol
<i>trans</i> -2,5-Diethyltetrahydrofuran	0.06	Furan
Hashishene	0.08	Monoterpene
$\alpha$ -Thujene	0.05	Monoterpene
$\alpha$ -Pinene	0.83	Monoterpene
<i>trans</i> -3-Methylcyclohexanol	0.02	Aliphatic alcohol
Camphene	0.02	Monoterpene
3-Methylcyclohexanone	0.03	Aliphatic ketone
Thuja-2,4(10)-diene	0.01	Monoterpene
Benzaldehyde	0.01	Simple phenolic
Sabinene	0.37	Monoterpene
$\beta$ -Pinene	0.73	Monoterpene
Octen-3-ol	0.01	Aliphatic alcohol
Octan-3-one	0.05	Aliphatic ketone
6-Methyl-5-hepten-2-one	0.01	Aliphatic ketone
Myrcene	1.77	Monoterpene
Octan-3-ol	0.62	Aliphatic alcohol
$\alpha$ -Phellandrene	0.02	Monoterpene
Pseudolimonene	0.06	Monoterpene
Octanal	0.03	Aliphatic aldehyde
$\Delta^3$ -Carene	0.01	Monoterpene
$\alpha$ -Terpinene	0.25	Monoterpene
Carvomenthene	0.05	Aliphatic alcohol
para-Cymene	0.29	Monoterpene
Limonene	13.89	Monoterpene
$\beta$ -Phellandrene	1.73*	Monoterpene
1,8-Cineole	[1.73]*	Monoterpenic ether
2-Ethylhexanol	0.01	Aliphatic alcohol
(Z)- $\beta$ -Ocimene	0.12	Monoterpene
(E)- $\beta$ -Ocimene	0.07	Monoterpene
$\gamma$ -Terpinene	0.45	Monoterpene
<i>cis</i> -Sabinene hydrate	0.51	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (fur.)	0.01	Monoterpenic alcohol

Octanol	0.04	Aliphatic alcohol
Terpinolene	0.16	Monoterpene
para-Cymenene	0.02	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	0.01	Monoterpenic alcohol
<i>trans</i> -Sabinene hydrate	0.06	Monoterpenic alcohol
Linalool	0.07	Monoterpenic alcohol
Nonanal	0.01	Aliphatic aldehyde
2-Methylbutyl 2-methylbutyrate	0.02	Aliphatic ester
Isoamyl isovalerate	0.02	Aliphatic ester
endo-Fenchol	0.01	Monoterpenic alcohol
<i>trans</i> -para-Mentha-2,8-dien-1-ol	0.08	Monoterpenic alcohol
Octan-3-yl acetate	0.18	Aliphatic ester
<i>trans</i> -Pinocarveol	0.05	Monoterpenic alcohol
<i>cis</i> -para-Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
Isopulegol	0.03	Monoterpenic alcohol
Menthone	0.76	Monoterpenic ketone
Isomenthone	0.09	Monoterpenic ketone
neo-Menthol	0.12	Monoterpenic alcohol
Menthol	0.53	Monoterpenic alcohol
Terpinen-4-ol	0.90	Monoterpenic alcohol
para-Cymen-8-ol	0.01	Monoterpenic alcohol
Isomenthol	0.01	Monoterpenic alcohol
neoiso-Menthol	0.02	Monoterpenic alcohol
$\alpha$ -Terpineol	0.04	Monoterpenic alcohol
<i>cis</i> -Dihydrocarvone	1.26	Monoterpenic ketone
<i>cis</i> -Piperitol	0.03	Monoterpenic alcohol
Myrtenol	0.01	Monoterpenic alcohol
Dihydrocarveol	0.23	Monoterpenic alcohol
neo-Dihydrocarveol	0.38	Monoterpenic alcohol
<i>trans</i> -Dihydrocarvone	0.26	Monoterpenic ketone
iso-Dihydrocarveol ?	0.03	Monoterpenic alcohol
<i>cis</i> -Carveol	0.35	Monoterpenic alcohol
Carvone	64.25	Monoterpenic ketone
Piperitone	0.41	Monoterpenic ketone
Isopiperitenone	0.04	Monoterpenic ketone
neo-Menthyl acetate	0.01	Monoterpenic ester
<i>trans</i> -Carvone oxide	0.06	Monoterpenic ketone
Decanol	0.05	Aliphatic alcohol
Dihydroedulan I	0.03	Terpenic ether
Menthyl acetate	0.06	Monoterpenic ester
Isomenthyl acetate	0.01	Monoterpenic alcohol
neo-Dihydrocarvyl acetate	0.04	Monoterpenic ester
Dihydrocarvyl acetate	0.26	Monoterpenic ester
Bicycloelemene	0.01	Sesquiterpene
<i>trans</i> -Carvyl acetate	0.02	Monoterpenic ester
Evodone	0.04	Monoterpenic ketone
Menthofuroolactone	0.06	Aliphatic alcohol
iso-Dihydrocarvyl acetate	0.01	Monoterpenic ester
<i>cis</i> -Carvyl acetate	0.29	Monoterpenic ester
$\alpha$ -Copaene	0.05	Sesquiterpene
$\beta$ -Bourbonene	1.12	Sesquiterpene
1,5-diepi- $\beta$ -Bourbonene	0.07	Sesquiterpene

β-Elemene	0.10	Sesquiterpene
(Z)-Jasmone	0.26	Jasmonate
Unknown	0.05	Sesquiterpene
β-Caryophyllene	1.14	Sesquiterpene
β-Ylangene	0.15	Sesquiterpene
β-Copaene	0.14	Sesquiterpene
Isogermacrene D	0.14	Sesquiterpene
α-Humulene	0.10	Sesquiterpene
allo-Aromadendrene	0.03	Sesquiterpene
(E)-β-Farnesene	0.55	Sesquiterpene
Unknown	0.05	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.02	Sesquiterpene
Germacrene D	0.82	Sesquiterpene
Bicyclogermacrene	0.02	Sesquiterpene
Viridiflorene	0.04	Sesquiterpene
α-Muurolene	0.05	Sesquiterpene
γ-Cadinene	0.02	Sesquiterpene
δ-Cadinene	0.07	Sesquiterpene
α-Cadinene	0.01	Sesquiterpene
1,5-Epoxysalvial-4(14)-ene	0.01	Sesquiterpenic ether
(E)-Nerolidol	0.01	Sesquiterpenic alcohol
Spathulenol	0.01	Sesquiterpenic alcohol
Caryophyllene oxide	0.05	Sesquiterpenic ether
Viridiflorol	0.17	Sesquiterpenic alcohol
Isospathulenol	0.01	Sesquiterpenic alcohol
τ-Cadinol	0.01	Sesquiterpenic alcohol
α-Muurolol	0.01	Sesquiterpenic alcohol
α-Cadinol	0.01	Sesquiterpenic alcohol
meta-Camphorene	0.02	Diterpene
para-Camphorene	0.02	Diterpene
<b>Consolidated total</b>	<b>99.16%</b>	

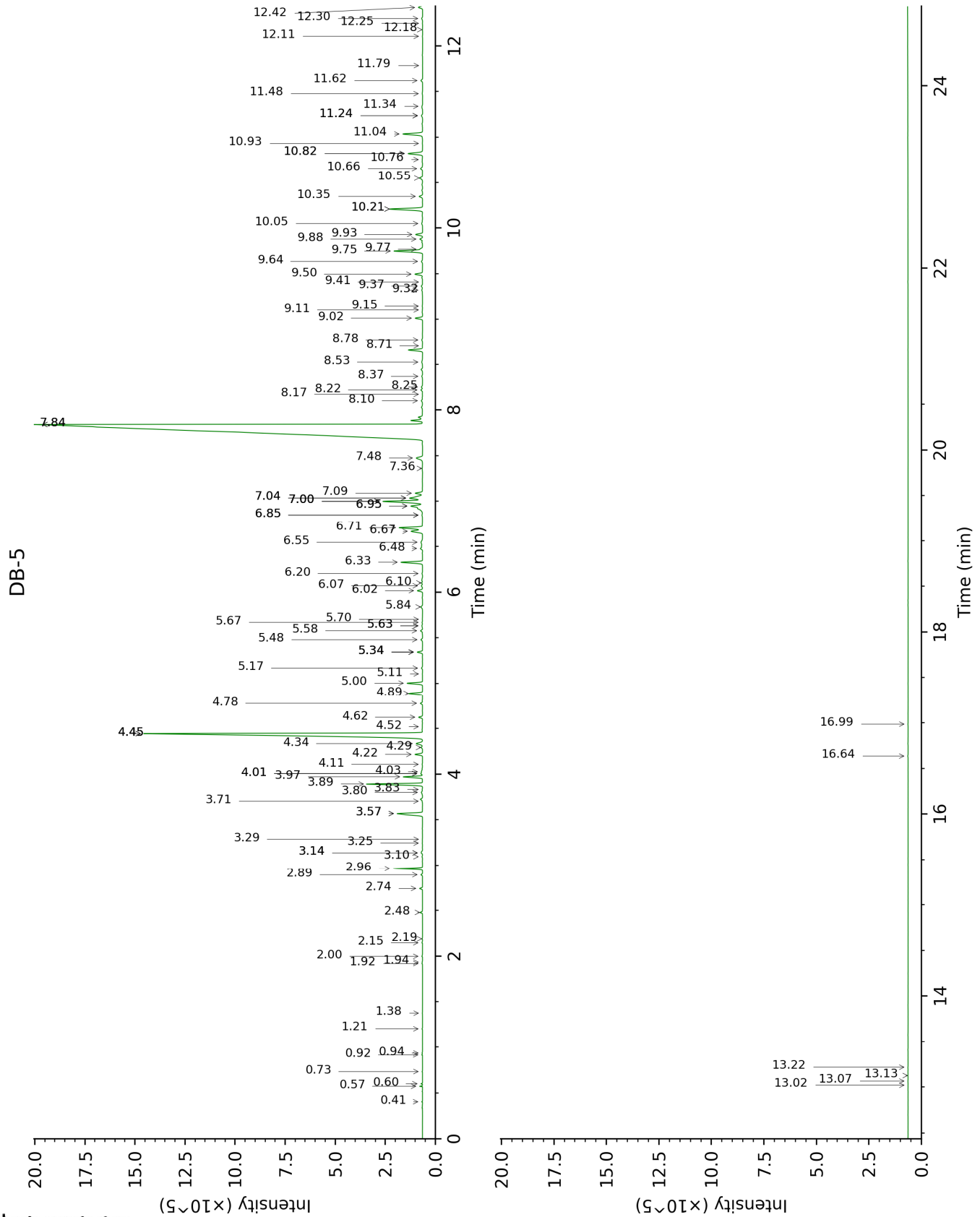
\*: Individual compounds concentration could not be found due to overlapping coelutions on columns considered  
[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated total

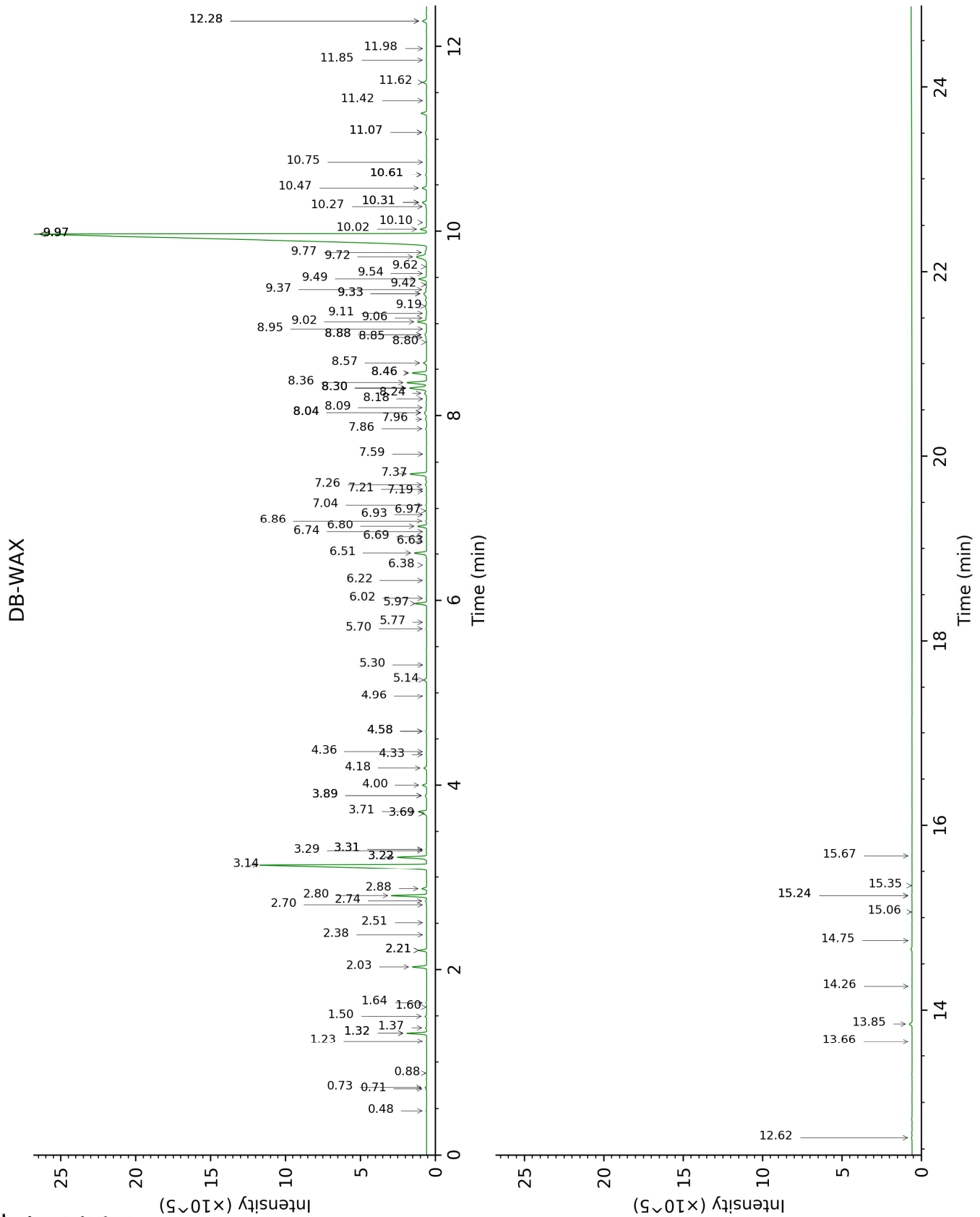
Note: no correction factor was applied

**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	%
Isobutyral	0.40	539	0.01	0.48	781	0.01
Isovaleral	0.57	642	0.04	0.73	887	0.04
2-Methylbutyral	0.60	652	0.02	0.71	881	0.02
2-Ethylfuran	0.73	702	0.01	0.88	919	0.01
Isoamyl alcohol	0.92	730	0.01	3.31*	1175	0.03
2-Methylbutanol	0.94	734	0.01	3.31*	1175	[0.03]
Methyl 2-methylbutyrate	1.21	774	0.01	1.23	977	0.01
Hexanal	1.38	799	0.01			
(2E)-Hexenal	1.92	848	0.01	3.29	1174	0.02
Ethyl 2-methylbutyrate	1.94	849	0.01	1.60	1023	0.01
(3Z)-Hexenol	2.00	854	0.02	5.70	1349	0.03
(2E)-Hexenol	2.15	867	0.01	6.02	1373	0.02
Hexanol	2.19	871	0.01	5.30	1321	0.01
trans-2,5-Diethyltetrahydrofuran	2.48	895	0.06	1.50	1013	0.06
Hashishene	2.74	915	0.08	1.32*	992	0.88
α-Thujene	2.89	925	0.05	1.37	1001	0.04
α-Pinene	2.96	930	0.83	1.32*	992	[0.88]
trans-3-Methylcyclohexanol	3.10	938	0.02	6.69	1422	0.02
Camphene	3.14*	941	0.06	1.64	1027	0.02
3-Methylcyclohexanone	3.14*	941	[0.06]	4.58*	1271	0.04
Thuja-2,4(10)-diene	3.25	948	0.01	2.21*	1084	0.38
Benzaldehyde	3.29	951	0.01	7.21	1460	0.01
Sabinene	3.57*	970	1.14	2.21*	1084	[0.38]
β-Pinene	3.57*	970	[1.14]	2.03	1066	0.73
Octen-3-ol	3.70	980	0.01	6.63	1417	0.01
Octan-3-one	3.80	986	0.05	3.89*	1220	0.10
6-Methyl-5-hepten-2-one	3.83	988	0.01	4.96	1300	0.01
Myrcene	3.89	992	1.77	2.80	1134	1.80
Octan-3-ol	3.97	998	0.62	5.97	1369	0.61
α-Phellandrene	4.01*†	1000	0.12	2.70	1126	0.02
Pseudolimonene	4.01*†	1000	[0.12]	2.74	1130	0.06
Octanal	4.03†	1001	[0.12]	4.33	1253	0.03
Δ3-Carene	4.11	1006	0.01	2.51	1111	0.01
α-Terpinene	4.22	1013	0.25	2.88	1140	0.25
Carvomenthene	4.29	1018	0.05	2.38	1101	0.01
para-Cymene	4.34	1021	0.29	4.00	1228	0.23
Limonene	4.44*	1028	15.62	3.14	1161	13.89
β-Phellandrene	4.44*	1028	[15.62]	3.22*	1168	1.65
1,8-Cineole	4.44*	1028	[15.62]	3.22*	1168	[1.65]
2-Ethylhexanol	4.52	1033	0.01	7.19	1459	0.01
(Z)-β-Ocimene	4.62	1039	0.12	3.69	1205	0.11
(E)-β-Ocimene	4.78	1049	0.07	3.89*	1220	[0.10]
γ-Terpinene	4.89	1056	0.45	3.72	1207	0.47

<i>cis</i> -Sabinene hydrate	5.00	1063	0.51	6.80	1430	0.51
<i>cis</i> -Linalool oxide (fur.)	5.11	1070	0.01	6.38	1399	0.01
Octanol	5.17	1074	0.04	8.09	1527	0.04
Terpinolene	5.34*	1085	0.17	4.18	1242	0.16
para-Cymenene	5.34*	1085	[0.17]	6.22	1387	0.02
<i>trans</i> -Linalool oxide (fur.)	5.34*	1085	[0.17]	6.74	1426	0.01
<i>trans</i> -Sabinene hydrate	5.48	1094	0.06	7.86	1510	0.06
Linalool	5.58	1100	0.07	7.96	1518	0.08
Nonanal	5.63*	1104	0.04	5.77	1354	0.01
2-Methylbutyl 2-methylbutyrate	5.63*	1104	[0.04]	4.36	1255	0.02
Isoamyl isovalerate	5.67	1106	0.02	4.58*	1271	[0.04]
endo-Fenchol	5.70	1108	0.01	8.30*	1544	1.25
<i>trans</i> -para-Mentha-2,8-dien-1-ol	5.84	1117	0.08	8.85	1587	0.04
Octan-3-yl acetate	6.02	1128	0.18	5.14	1309	0.16
<i>trans</i> -Pinocarveol	6.07	1132	0.05	9.06	1604	0.07
<i>cis</i> -para-Mentha-2,8-dien-1-ol	6.10	1134	0.03	9.37	1629	0.08
Isopulegol	6.20	1141	0.03	8.04*	1523	0.24
Menthone	6.33	1149	0.76	6.51	1408	0.77
Isomenthone	6.48	1158	0.09	6.86	1435	0.05
neo-Menthol	6.55	1163	0.12	8.46*	1557	0.89
Menthol	6.67	1171	0.53	9.02	1600	0.57
Terpinen-4-ol	6.71	1173	0.90	8.46*	1557	[0.89]
para-Cymen-8-ol	6.85*	1183	0.03	11.42	1800	0.01
Isomenthol	6.85*	1183	[0.03]	8.80	1583	0.01
neoiso-Menthol	6.95*†	1189	3.09	9.33*	1625	0.28
α-Terpineol	6.95*†	1189	[3.09]	9.62	1649	0.04
<i>cis</i> -Dihydrocarvone	7.00*†	1193	[3.09]	8.36	1549	1.26
<i>cis</i> -Piperitol	7.00*†	1193	[3.09]	9.42	1633	0.03
Myrtenol	7.00*†	1193	[3.09]	10.75	1743	0.01
Dihydrocarveol	7.04*†	1195	[3.09]	10.31*	1706	0.31
neo-Dihydrocarveol	7.04*†	1195	[3.09]	10.02	1682	0.38
<i>trans</i> -Dihydrocarvone	7.09	1198	0.26	8.57	1565	0.21
iso-Dihydrocarveol ?	7.36	1217	0.03	10.61*	1732	0.08
<i>cis</i> -Carveol	7.48	1224	0.35	11.62	1818	0.21
Carvone	7.84*†	1250	63.21	9.97*	1678	64.32
Piperitone	7.84*†	1250	[63.21]	9.77†	1661	[1.24]
Isopiperitenone	8.10	1267	0.04	11.08*	1771	0.11
neo-Menthyl acetate	8.17	1272	0.01	7.59	1489	0.01
<i>trans</i> -Carvone oxide	8.22	1275	0.06	11.08*	1771	[0.11]
Decanol	8.25	1278	0.05	10.61*	1732	[0.08]
Dihydroedulan I	8.37	1286	0.03	6.98	1443	0.03
Menthyl acetate	8.53	1296	0.06	8.04*	1523	[0.24]
Isomenthyl acetate	8.71	1306	0.01	8.18	1535	0.01
neo-Dihydrocarvyl acetate	8.78	1310	0.04	8.88*	1590	0.15
Dihydrocarvyl acetate	9.02	1327	0.26	9.33*	1625	[0.28]
Bicycloelemene	9.10	1334	0.01	6.94	1440	0.02

<i>trans</i> -Carvyl acetate	9.15	1336	0.02	10.10	1688	0.02
Evodone	9.32	1349	0.04	12.28*	1877	0.27
Menthofuro lactone	9.37	1352	0.06	11.85	1839	0.02
iso-Dihydrocarvyl acetate	9.41	1355	0.01			
<i>cis</i> -Carvyl acetate	9.50	1361	0.29	10.47	1719	0.28
$\alpha$ -Copaene	9.64	1371	0.05	7.04	1448	0.04
$\beta$ -Bourbonene	9.75	1379	1.12	7.37	1473	1.08
1,5-diepi- $\beta$ -Bourbonene	9.77	1381	0.07	7.26	1464	0.08
$\beta$ -Elemene	9.88	1388	0.10	8.30*	1544	[1.25]
( <i>Z</i> )-Jasmone	9.93	1392	0.26	12.28*	1877	[0.27]
Unknown [m/z 106, 119 (99), 43 (78), 91 (74), 105 (60), 134 (55)... 204 (19)]	10.05	1400	0.05			
$\beta$ -Caryophyllene	10.21*	1412	1.33	8.30*	1544	[1.25]
$\beta$ -Ylangene	10.21*	1412	[1.33]	8.04*	1523	[0.24]
$\beta$ -Copaene	10.35	1423	0.14	8.24	1540	0.16
Isogermacrene D	10.55	1438	0.14	8.88*	1590	[0.15]
$\alpha$ -Humulene	10.66	1446	0.10	9.19	1614	0.13
allo-Aromadendrene	10.76	1453	0.03	8.95	1594	0.02
( <i>E</i> )- $\beta$ -Farnesene	10.82*	1458	0.60	9.49	1638	0.55
Unknown [m/z 161, 105 (56), 91 (50), 93 (36), 119 (33), 79 (31)...204 (5)]	10.82*	1458	[0.60]			
<i>trans</i> -Cadina-1(6),4-diene	10.93	1466	0.02	9.11	1608	0.02
Germacrene D	11.04	1474	0.82	9.72†	1658	1.24
Bicyclgermacrene	11.24*	1489	0.06	9.97*	1678	[64.32]
Viridiflorene	11.24*	1489	[0.06]	9.54	1643	0.04
$\alpha$ -Muurolene	11.34	1497	0.05	9.97*	1678	[64.32]
$\gamma$ -Cadinene	11.48	1507	0.02	10.27	1702	0.06
$\delta$ -Cadinene	11.62	1519	0.07	10.31*	1706	[0.31]
$\alpha$ -Cadinene	11.79	1532	0.01	10.61*	1732	[0.08]
1,5-Epoxysalvial-4(14)-ene	12.11	1557	0.01	11.98	1850	0.01
( <i>E</i> )-Nerolidol	12.18	1563	0.01	13.66	2004	0.01
Spathulenol	12.25	1568	0.01	14.26	2062	0.01
Caryophyllene oxide	12.30	1572	0.05	12.62	1908	0.04
Viridiflorol	12.42	1582	0.17	13.85	2023	0.17
Isospathulenol	13.02	1630	0.01	15.24*	2159	0.02
$\tau$ -Cadinol	13.07	1634	0.01	14.75	2110	0.01
$\alpha$ -Muurolol	13.13	1639	0.01	15.06	2141	0.01
$\alpha$ -Cadinol	13.22	1646	0.01	15.35	2170	0.01
meta-Camphorene	16.64	1950	0.02	15.24*	2159	[0.02]
para-Camphorene	16.99	1984	0.02	15.67	2203	0.01
<b>Total identified</b>		<b>98.88%</b>			<b>98.50%</b>	
<b>Total reported</b>		<b>98.93%</b>			<b>98.50%</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

Note: no correction factor was applied

R.T.: Retention time (minutes)

R.I.: Retention index