

Date : July 15, 2022

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

**Internal code** : 22G08-PTH03

**Customer identification** : Spearmint - USA - S30111R

**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** : Pamela Lavoie, M.Sc., Chimiste

**Analysis date** : July 14, 2022

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4898 \pm 0.0003$  (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	tr	Furan
Isoamyl alcohol	0.01	Aliphatic alcohol
2-Methylbutanol	0.01	Aliphatic alcohol
Methyl 2-methylbutyrate	0.01	Aliphatic ester
Hexanal	tr	Aliphatic aldehyde
(2E)-Hexenal	0.03	Aliphatic aldehyde
Ethyl 2-methylbutyrate	0.01	Aliphatic ester
(3Z)-Hexenol	0.02	Aliphatic alcohol
(2E)-Hexenol	0.02	Aliphatic alcohol
Hexanol	0.02	Aliphatic alcohol
<i>trans</i> -2,5-Diethyltetrahydrofuran	0.06	Furan
Hashishene	0.10	Monoterpene
$\alpha$ -Thujene	0.04	Monoterpene
$\alpha$ -Pinene	0.56	Monoterpene
3-Methylcyclohexanone	0.01	Aliphatic ketone
Camphene	0.02	Monoterpene
$\alpha$ -Fenchene	tr	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
Sabinene	0.35	Monoterpene
$\beta$ -Pinene	0.63	Monoterpene
Octen-3-ol	0.02	Aliphatic alcohol
<i>cis</i> -Carane	tr	Monoterpene
Octan-3-one	0.02	Aliphatic ketone
Myrcene	1.91	Monoterpene
Octan-3-ol	0.73	Aliphatic alcohol
Pseudolimonene	0.04	Monoterpene
Octanal	0.03	Aliphatic aldehyde
$\alpha$ -Phellandrene	0.02	Monoterpene
$\alpha$ -Terpinene	0.23	Monoterpene
Carvomenthene	0.01	Aliphatic alcohol
<i>para</i> -Cymene	0.11	Monoterpene
Limonene	13.76	Monoterpene
1,8-Cineole	1.65	Monoterpenic ether
2-Ethylhexanol	0.01	Aliphatic alcohol
(Z)- $\beta$ -Ocimene	0.14	Monoterpene
Unknown	0.01	Unknown
(E)- $\beta$ -Ocimene	0.08	Monoterpene
$\gamma$ -Terpinene	0.38	Monoterpene
<i>cis</i> -Sabinene hydrate	0.66	Monoterpenic alcohol
Octanol	0.03	Aliphatic alcohol
Terpinolene	0.12	Monoterpene
<i>para</i> -Cymenene	0.02	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	0.01	Monoterpenic alcohol

<i>trans</i> -Sabinene hydrate	0.06	Monoterpenic alcohol
Linalool	0.06	Monoterpenic alcohol
Nonanal	0.03	Aliphatic aldehyde
2-Methylbutyl 2-methylbutyrate	0.02	Aliphatic ester
Isoamyl isovalerate	tr	Aliphatic ester
endo-Fenchol	0.01	Monoterpenic alcohol
Octen-3-yl acetate	0.01	Aliphatic ester
<i>trans</i> -para-Mentha-2,8-dien-1-ol	0.07	Monoterpenic alcohol
Octan-3-yl acetate	0.23	Aliphatic ester
<i>cis</i> -Limonene oxide	0.01	Monoterpenic ether
<i>cis</i> -para-Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
<i>trans</i> -Pinocarveol	0.04	Monoterpenic alcohol
<i>trans</i> -Limonene oxide	0.04	Monoterpenic ether
Isopulegol	0.03	Monoterpenic alcohol
Menthone	0.69	Monoterpenic ketone
Isomenthone	0.04	Monoterpenic ketone
Menthofuran	tr	Monoterpenic ether
Borneol	0.03	Monoterpenic alcohol
neo-Menthol	0.15	Monoterpenic alcohol
Terpinen-4-ol	0.51	Monoterpenic alcohol
Menthol	0.79	Monoterpenic alcohol
para-Cymen-8-ol	0.01	Monoterpenic alcohol
$\alpha$ -Terpineol	0.16	Monoterpenic alcohol
neoiso-Menthol	0.11	Monoterpenic alcohol
<i>cis</i> -Dihydrocarvone	1.34	Monoterpenic ketone
neo-Dihydrocarveol	0.54	Monoterpenic alcohol
Methylchavicol	0.02	Phenylpropanoid
Dihydrocarveol	0.37	Monoterpenic alcohol
<i>trans</i> -Dihydrocarvone	0.18	Monoterpenic ketone
<i>trans</i> -Piperitol	0.01	Monoterpenic alcohol
Decanal	0.01	Aliphatic aldehyde
iso-Dihydrocarveol ?	0.02	Monoterpenic alcohol
<i>trans</i> -Carveol	0.31	Monoterpenic alcohol
Pulegone	0.02	Monoterpenic ketone
Carvone	64.23	Monoterpenic ketone
Piperitone	0.20	Monoterpenic ketone
<i>cis</i> -Carveol	0.24	Monoterpenic alcohol
Isopiperitenone	0.05	Monoterpenic ketone
<i>trans</i> -Carvone oxide	0.08	Monoterpenic ketone
Decanol	0.01	Aliphatic alcohol
Dihydroedulan I	0.04	Terpenic ether
Menthyl acetate	0.06	Monoterpenic ester
Dihydroedulan II	0.02	Terpenic ether
Isomenthyl acetate	0.01	Monoterpenic alcohol
Dihydrocarvyl acetate	0.47	Monoterpenic ester
Bicycloelemene	0.01	Sesquiterpene
<i>trans</i> -Carvyl acetate	0.02	Monoterpenic ester
Evodone	0.03	Monoterpenic ketone
$\alpha$ -Cubebene	tr	Sesquiterpene
Menthofuro lactone	0.02	Aliphatic alcohol
iso-Dihydrocarvyl acetate	0.05	Monoterpenic ester
<i>cis</i> -Carvyl acetate	0.34	Monoterpenic ester

α-Copaene	0.05	Sesquiterpene
β-Bourbonene	1.26	Sesquiterpene
1,5-diepi-β-Bourbonene	0.10	Sesquiterpene
β-Elemene	0.08	Sesquiterpene
(Z)-Jasmone	0.25	Jasmonate
Unknown	0.02	Unknown
Isocaryophyllene	0.05	Sesquiterpene
β-Caryophyllene	1.06	Sesquiterpene
β-Ylangene	0.10	Sesquiterpene
β-Copaene	0.15	Sesquiterpene
Aromadendrene	0.04	Sesquiterpene
Isogermacrene D	0.14	Sesquiterpene
α-Humulene	0.09	Sesquiterpene
allo-Aromadendrene	0.02	Sesquiterpene
(E)-β-Farnesene	0.61	Sesquiterpene
Unknown	0.11	Sesquiterpene
trans-Cadina-1(6),4-diene	0.01	Sesquiterpene
γ-Murolene	0.01	Sesquiterpene
Germacrene D	0.75	Sesquiterpene
Bicyclogermacrene	tr	Sesquiterpene
Phenylethyl 2-methylbutyrate	0.02	Phenolic ester
α-Murolene	0.01	Sesquiterpene
γ-Cadinene	0.02	Sesquiterpene
δ-Cadinene	0.06	Sesquiterpene
Caryophyllene oxide isomer	0.01	Sesquiterpenic ether
Caryophyllene oxide	0.03	Sesquiterpenic ether
Viridiflorol	0.16	Sesquiterpenic alcohol
Isospathulenol	0.01	Sesquiterpenic alcohol
α-Cadinol	0.01	Sesquiterpenic alcohol
meta-Camphorene	0.01	Diterpene
para-Camphorene	0.01	Diterpene
<b>Consolidated total</b>	<b>99.01%</b>	

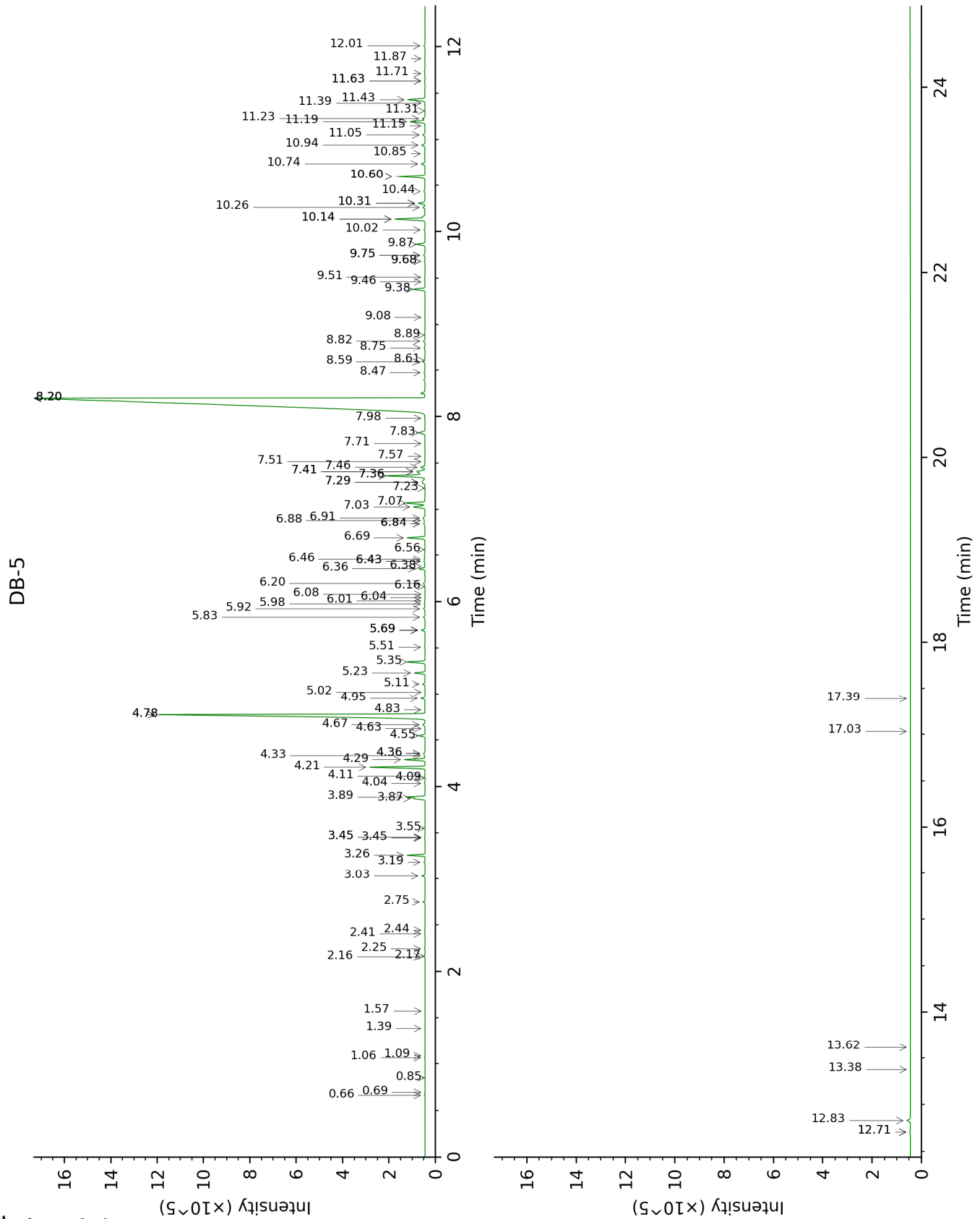
tr: The compound has been detected below 0.005% of total signal.

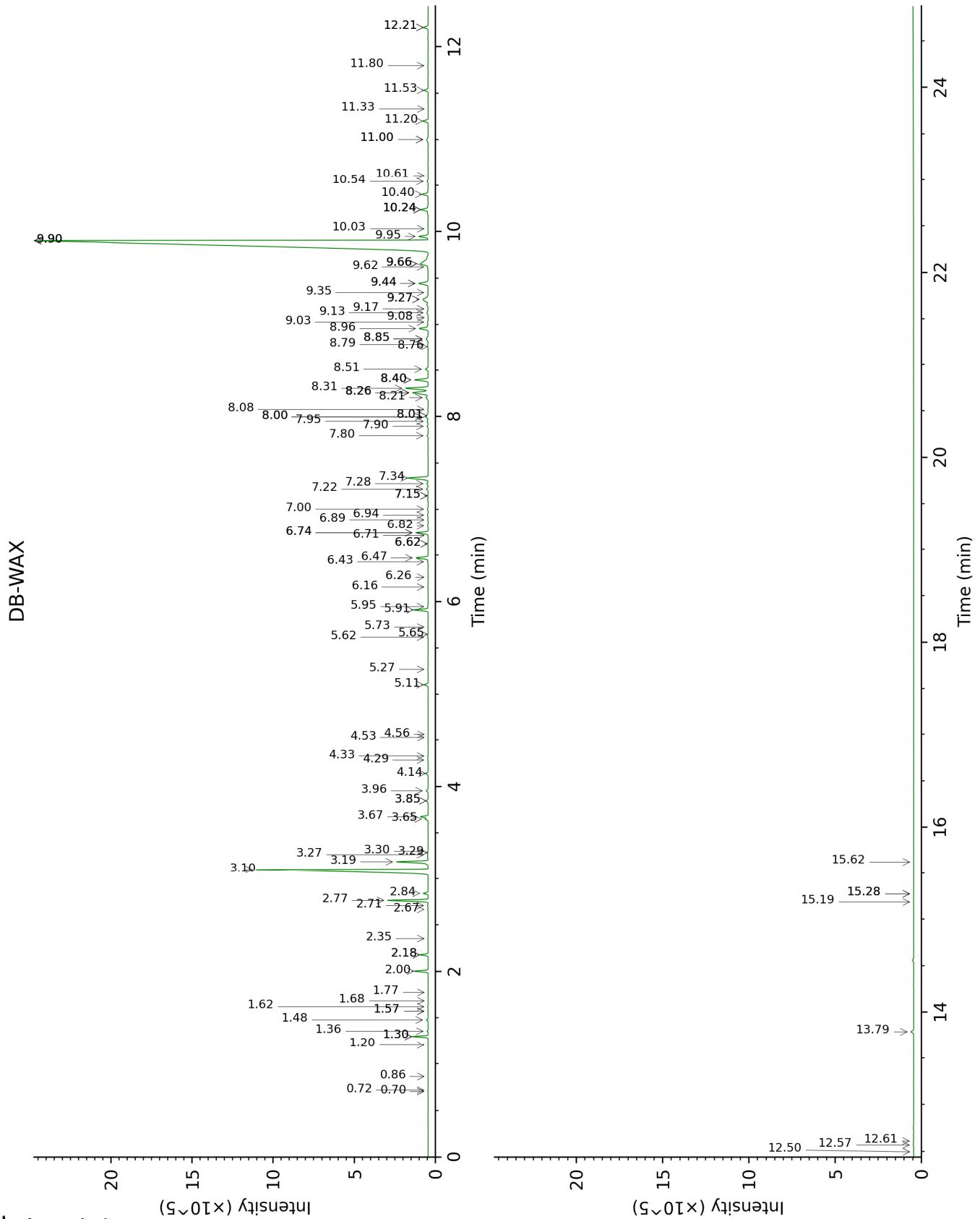
Note: no correction factor was applied

**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	%
Isovaleral	0.66	643	0.01	0.72	882	0.01
2-Methylbutyral	0.69	653	0.01	0.70	877	tr
2-Ethylfuran	0.85	702	tr	0.86	917	tr
Isoamyl alcohol	1.06	732	0.01	3.30†	1174	[0.02]
2-Methylbutanol	1.09	735	0.01	3.29†	1173	0.02
Methyl 2-methylbutyrate	1.39	774	0.01	1.20	973	0.01
Hexanal	1.57	799	tr	1.78	1041	tr
(2E)-Hexenal	2.16†	848	0.04	3.27	1172	0.03
Ethyl 2-methylbutyrate	2.16†	848	[0.04]	1.57*	1021	0.01
(3Z)-Hexenol	2.24	855	0.02	5.62	1344	0.03
(2E)-Hexenol	2.41	868	0.02	5.95	1368	0.03
Hexanol	2.44	871	0.02	5.27	1319	0.02
<i>trans</i> -2,5-Diethyltetrahydrofuran	2.75	896	0.06	1.48	1012	0.06
Hashishene	3.03	916	0.10	1.30*	989	0.66
$\alpha$ -Thujene	3.18	926	0.04	1.36	998	0.04
$\alpha$ -Pinene	3.26	931	0.56	1.30*	989	[0.66]
3-Methylcyclohexanone	3.45†	943	0.03	4.53	1267	0.01
Camphene	3.45*†	943	[0.03]	1.62	1026	0.02
$\alpha$ -Fenchene	3.45*†	943	[0.03]	1.57*	1021	[0.01]
Thuja-2,4(10)-diene	3.55	950	0.01	2.18*	1082	0.36
Sabinene	3.87†	971	0.98	2.18*	1082	[0.36]
$\beta$ -Pinene	3.89†	972	[0.98]	2.00	1064	0.63
Octen-3-ol	4.04	982	0.02	6.62*	1417	0.02
<i>cis</i> -Carane	4.09	985	tr	1.68	1032	tr
Octan-3-one	4.11	987	0.02	3.85*†	1217	0.11
Myrcene	4.21	993	1.91	2.77	1132	1.91
Octan-3-ol	4.29	998	0.73	5.91	1365	0.74
Pseudolimonene	4.33	1001	0.04	2.71	1128	0.03
Octanal	4.36*	1003	0.06	4.29	1249	0.03
$\alpha$ -Phellandrene	4.36*	1003	[0.06]	2.67	1124	0.02
$\alpha$ -Terpinene	4.55	1015	0.23	2.84	1138	0.23
Carvomenthene	4.63	1020	0.01	2.36	1099	0.01
<i>para</i> -Cymene	4.67	1022	0.11	3.96	1225	0.10
Limonene	4.78*	1029	15.43	3.10	1159	13.76
1,8-Cineole	4.78*	1029	[15.43]	3.19	1166	1.65
2-Ethylhexanol	4.83	1032	0.01	7.15*	1456	0.03
(Z)- $\beta$ -Ocimene	4.95	1040	0.14	3.65	1202	0.14
Unknown [m/z 57, 73 (49), 115 (34), 93 (27), 43 (28)...]	5.02	1044	0.01			
(E)- $\beta$ -Ocimene	5.11	1050	0.08	3.85*†	1217	[0.11]
$\gamma$ -Terpinene	5.23	1058	0.38	3.68	1204	0.39
<i>cis</i> -Sabinene hydrate	5.35	1065	0.66	6.74*	1426	0.66
Octanol	5.51	1075	0.03	8.01*†	1522	[0.20]
Terpinolene	5.69*	1087	0.13	4.14	1238	0.12

para-Cymenene	5.69*	1087	[0.13]	6.16	1383	0.02
<i>trans</i> -Linalool oxide (fur.)	5.69*	1087	[0.13]	6.71	1424	0.01
<i>trans</i> -Sabinene hydrate	5.83	1096	0.06	7.80	1505	0.06
Linalool	5.92	1101	0.06	7.90	1513	0.06
Nonanal	5.98	1105	0.03	5.73	1352	0.02
2-Methylbutyl 2-methylbutyrate	6.01	1107	0.02	4.33	1252	0.02
Isoamyl isovalerate	6.04	1109	tr	4.56	1270	tr
endo-Fenchol	6.08	1111	0.01	8.26*	1541	1.15
Octen-3-yl acetate	6.16	1117	0.01	5.65	1346	0.01
<i>trans</i> -para-Mentha-2,8-dien-1-ol	6.20	1119	0.07	8.76	1580	0.03
Octan-3-yl acetate	6.36	1129	0.23	5.10	1307	0.22
<i>cis</i> -Limonene oxide	6.38	1131	0.01	6.26	1391	0.01
<i>cis</i> -para-Mentha-2,8-dien-1-ol	6.43*	1134	0.05	9.35	1627	0.03
<i>trans</i> -Pinocarveol	6.43*	1134	[0.05]	9.03	1601	0.04
<i>trans</i> -Limonene oxide	6.46	1136	0.04	6.43	1403	0.04
Isopulegol	6.56	1142	0.03	8.00*†	1521	0.20
Menthone	6.69	1151	0.69	6.47	1406	0.69
Isomenthone	6.84*†	1160	0.22	6.82	1432	0.04
Menthofuran	6.84*†	1160	[0.22]	6.74*	1426	[0.66]
Borneol	6.88†	1163	[0.22]	9.62	1650	0.03
neo-Menthol	6.91†	1165	[0.22]	8.40*	1552	0.77
Terpinen-4-ol	7.03	1173	0.51	8.40*	1552	[0.77]
Menthol	7.07	1175	0.79	8.96	1596	0.56
para-Cymen-8-ol	7.23	1186	0.01	11.33	1793	0.01
α-Terpineol	7.29*	1190	0.27	9.66*	1652	1.11
neoiso-Menthol	7.29*	1190	[0.27]	9.27*	1621	0.58
<i>cis</i> -Dihydrocarvone	7.36*	1194	1.72	8.31	1545	1.34
neo-Dihydrocarveol	7.36*	1194	[1.72]	9.95	1676	0.54
Methylchavicol	7.41*	1197	0.52	9.17	1613	0.02
Dihydrocarveol	7.41*	1197	[0.52]	10.24*	1700	0.45
<i>trans</i> -Dihydrocarvone	7.46	1200	0.18	8.51	1561	0.16
<i>trans</i> -Piperitol	7.52	1204	0.01	10.24*	1700	[0.45]
Decanal	7.57	1208	0.01	7.15*	1456	[0.03]
iso-Dihydrocarveol ?	7.71	1218	0.02	10.61	1732	0.01
<i>trans</i> -Carveol	7.83	1225	0.31	11.20	1782	0.31
Pulegone	7.98	1236	0.02	8.79	1582	0.02
Carvone	8.20*	1251	64.67	9.90*	1673	64.37
Piperitone	8.20*	1251	[64.67]	9.66*	1652	[1.11]
<i>cis</i> -Carveol	8.20*	1251	[64.67]	11.53	1811	0.24
Isopiperitenone	8.48	1270	0.05	11.00*	1765	0.13
<i>trans</i> -Carvone oxide	8.59	1277	0.08	11.00*	1765	[0.13]
Decanol	8.61	1279	0.01	10.54	1726	0.07
Dihydroedulan I	8.75	1288	0.04	6.94	1441	0.04
Menthyl acetate	8.82	1293	0.06	7.95	1517	0.06
Dihydroedulan II	8.89	1298	0.02	7.28	1466	0.08
Isomenthyl acetate	9.08	1306	0.01	8.08	1527	0.02
Dihydrocarvyl acetate	9.38	1328	0.47	9.27*	1621	[0.58]

Bicycloelemene	9.46	1333	0.01	6.89	1437	0.02
<i>trans</i> -Carvyl acetate	9.51	1337	0.02	10.03	1683	0.02
Evodone	9.68*	1349	0.03	12.21*	1871	0.28
$\alpha$ -Cubebene	9.68*	1349	[0.03]	6.62*	1417	[0.02]
Menthofuro lactone	9.75*	1354	0.06	11.80	1834	0.02
iso-Dihydrocarvyl acetate	9.75*	1354	[0.06]			
<i>cis</i> -Carvyl acetate	9.86	1362	0.34	10.40	1714	0.34
$\alpha$ -Copaene	10.02	1373	0.05	7.00	1446	0.05
$\beta$ -Bourbonene	10.14*†	1381	1.36	7.34	1471	1.26
1,5-diepi- $\beta$ -Bourbonene	10.14*†	1381	[1.36]	7.22	1462	0.10
$\beta$ -Elemene	10.26	1390	0.08	8.26*	1541	[1.15]
( <i>Z</i> )-Jasmone	10.31*	1393	0.27	12.21*	1871	[0.28]
Unknown [m/z 107, 121 (79), 119 (66), 91 (58), 136 (55), 105 (49)... 194 (1)]	10.31*	1393	[0.27]			
Isocaryophyllene	10.44	1402	0.05	8.01*†	1522	[0.20]
$\beta$ -Caryophyllene	10.60*	1414	1.25	8.26*	1541	[1.15]
$\beta$ -Ylangene	10.60*	1414	[1.25]	8.00*†	1521	[0.20]
$\beta$ -Copaene	10.74	1425	0.15	8.21	1537	0.17
Aromadendrene	10.85	1433	0.04	8.40*	1552	[0.77]
Isogermacrene D	10.94	1440	0.14	8.85*	1587	0.18
$\alpha$ -Humulene	11.05	1448	0.09	9.13	1609	0.10
allo-Aromadendrene	11.15	1455	0.02	8.85*	1587	[0.18]
( <i>E</i> )- $\beta$ -Farnesene	11.19	1459	0.61	9.44*	1635	0.66
Unknown [m/z 161, 105 (56), 91 (50), 93 (36), 119 (33), 79 (31)...204 (5)]	11.23	1461	0.11			
<i>trans</i> -Cadina-1(6),4-diene	11.31	1467	0.01	9.08	1605	0.01
$\gamma$ -Muurolene	11.39	1474	0.01	9.44*	1635	[0.66]
Germacrene D	11.43	1476	0.75	9.66*	1652	[1.11]
Bicyclgermacrene	11.63*	1491	0.03	9.90*	1673	[64.37]
Phenylethyl 2-methylbutyrate	11.63*	1491	[0.03]	12.61	1907	0.02
$\alpha$ -Muurolene	11.71	1497	0.01	9.90*	1673	[64.37]
$\gamma$ -Cadinene	11.87	1510	0.02	10.24*	1700	[0.45]
$\delta$ -Cadinene	12.01	1520	0.06	10.24*	1700	[0.45]
Caryophyllene oxide isomer	12.71*	1575	0.03	12.50	1897	0.01
Caryophyllene oxide	12.71*	1575	[0.03]	12.57	1903	0.03
Viridiflorol	12.83	1585	0.16	13.79	2017	0.16
Isospathulenol	13.38	1629	0.01	15.28*	2163	0.01
$\alpha$ -Cadinol	13.62	1649	0.01	15.28*	2163	[0.01]
meta-Camphorene	17.03	1952	0.01	15.19	2154	0.01
para-Camphorene	17.39	1985	0.01	15.62	2198	0.01
<b>Total identified</b>		<b>98.96%</b>			<b>98.94%</b>	
<b>Total reported</b>		<b>99.08%</b>			<b>98.94%</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