

**Date :** January 29, 2021

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 21A28-PTH06


**Customer identification :** Peppermint - India - P501110203R

**Type :** Essential oil

**Source :** *Mentha x piperita*

**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 :** January 29, 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*Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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:** 1.4595 ± 0.0003 (20 °C; method PC-MAT-016)

EUROPEAN PHARMACOPOEIA 9.0 - 07/2012:0405 - PEPPERMINT OIL

Compound	Min. %	Max. %	Observed %	Complies?
Carvone		1.0	0.1	Yes
Pulegone		3.0	0.7	Yes
Menthol	30.0	55.0	40.2	Yes
Menthyl acetate	2.8	10.0	5.2	Yes
Isomenthone	1.5	10.0	4.1	Yes
Menthofuran	1.0	8.0	1.9	Yes
Menthone	14.0	32.0	24.8	Yes
1,8-Cineole	3.5	8.0	5.5	Yes
Limonene	1.0	3.5	2.2	Yes
Total isopulegol		0.20	0.19	Yes
<b>Refractive index</b>	1.457	1.467	1.460	Yes

NFT 75-210:2007 & ISO 856:2006 - OIL OF PEPPERMINT - "OTHER ORIGINS"

Compound	Min. %	Max. %	Observed %	Complies?
β-Caryophyllene	1.0	3.5	1.5	Yes
Menthyl acetate	2.0	8.0	5.2	Yes
Pulegone	0.5	3.0	0.7	Yes
Menthol	32.0	49.0	40.2	Yes
neo-Menthol	2.0	6.0	2.9	Yes
Menthofuran	1.0	8.0	1.9	Yes
Isomenthone	2.0	8.0	4.1	Yes
Menthone	13.0	28.0	24.8	Yes
cis-Sabinene hydrate	0.5	2.0	0.3	No
Limonene	1.0	3.0	2.2	Yes
1,8-Cineole	3.0	8.0	5.5	Yes
Octan-3-ol	0.1	0.5	0.2	Yes
<b>Refractive index</b>	1.459	1.465	1.460	Yes

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	tr	Aliphatic aldehyde
Isovaleral	0.02	Aliphatic aldehyde
2-Methylbutyral	0.01	Aliphatic aldehyde
Isoamyl alcohol	0.02	Aliphatic alcohol
2-Methylbutanol	0.01	Aliphatic alcohol
Ethyl 2-methylbutyrate	0.01	Aliphatic ester
(3Z)-Hexenol	0.02	Aliphatic alcohol
Hexanol	0.01	Aliphatic alcohol
<i>trans</i> -2,5-Diethyltetrahydrofuran	0.03	Furan
$\alpha$ -Thujene	0.04	Monoterpene
$\alpha$ -Pinene	0.73	Monoterpene
Camphene	0.04	Monoterpene
Thuja-2,4(10)-diene	tr	Monoterpene
Benzaldehyde	tr	Simple phenolic
$\beta$ -Pinene	0.93	Monoterpene
Sabinene	0.38	Monoterpene
Octen-3-ol	0.05	Aliphatic alcohol
Octan-3-one	0.02	Aliphatic ketone
Myrcene	0.25	Monoterpene
Octan-3-ol	0.18	Aliphatic alcohol
$\alpha$ -Phellandrene	0.05	Monoterpene
Pseudolimonene	0.02	Monoterpene
$\alpha$ -Terpinene	0.22	Monoterpene
para-Cymene	0.22	Monoterpene
Limonene	2.23	Monoterpene
1,8-Cineole	5.46	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.18	Monoterpene
(E)- $\beta$ -Ocimene	0.06	Monoterpene
$\gamma$ -Terpinene	0.38	Monoterpene
<i>cis</i> -Sabinene hydrate	0.27	Monoterpenic alcohol
<i>cis</i> -Linalool oxide (fur.)	0.01	Monoterpenic alcohol
Octanol	0.09	Aliphatic alcohol
para-Cymenene	tr	Monoterpene
Terpinolene	0.12	Monoterpene
<i>trans</i> -Sabinene hydrate	0.03	Monoterpenic alcohol
Nonan-3-ol	0.03	Aliphatic alcohol
Linalool	0.16	Monoterpenic alcohol
2-Methylbutyl 2-methylbutyrate	0.05	Aliphatic ester
Amyl isovalerate	0.04	Aliphatic ester
Octen-3-yl acetate	0.01	Aliphatic ester
<i>cis</i> -para-Menth-2-en-1-ol	0.05	Monoterpenic alcohol
Octan-3-yl acetate	0.01	Aliphatic ester
allo-Ocimene	0.01	Monoterpene
<i>trans</i> -Sabinol	0.06	Monoterpenic alcohol
Isopulegol	0.19	Monoterpenic alcohol

Menthone	24.75	Monoterpenic ketone
Isomenthone	4.12	Monoterpenic ketone
Menthofuran	1.88	Monoterpenic ether
neo-Menthol	2.90	Monoterpenic alcohol
$\delta$ -Terpineol	0.05	Monoterpenic alcohol
Terpinen-4-ol	0.63	Monoterpenic alcohol
Menthol	40.17	Monoterpenic alcohol
Isomenthol	0.53	Monoterpenic alcohol
$\alpha$ -Terpineol	0.10	Monoterpenic alcohol
Myrtenal	0.02	Monoterpenic aldehyde
neoiso-Menthol	0.20	Monoterpenic alcohol
Methylchavicol	0.04	Phenylpropanoid
<i>trans</i> -Isopiperitenol	0.01	Monoterpenic alcohol
Unknown	0.01	Unknown
<i>trans</i> -Piperitol	0.02	Monoterpenic alcohol
Citronellol	0.02	Monoterpenic alcohol
Pulegone	0.72	Monoterpenic ketone
Carvone	0.11	Monoterpenic ketone
Piperitone	0.39	Monoterpenic ketone
Decanol	0.02	Aliphatic alcohol
neo-Menthyl acetate	0.27	Monoterpenic ester
2-Ethylmenthone?	0.04	Aliphatic ketone
Dihydroedulan I	0.05	Terpenic ether
Menthyl acetate	5.18	Monoterpenic ester
Dihydroedulan II	0.06	Terpenic ether
Thymol	0.05	Monoterpenic alcohol
Isomenthyl acetate	0.18	Monoterpenic alcohol
Bicycloelemene	0.03	Sesquiterpene
$\alpha$ -Cubebene	0.01	Sesquiterpene
Eugenol	0.01	Phenylpropanoid
$\alpha$ -Copaene	0.03	Sesquiterpene
$\beta$ -Bourbonene	0.13	Sesquiterpene
1,5-diepi- $\beta$ -Bourbonene	0.02	Sesquiterpene
$\beta$ -Cubebene	0.01	Sesquiterpene
$\beta$ -Elemene	0.06	Sesquiterpene
Unknown	0.02	Unknown
( <i>Z</i> )-Jasmone	0.02	Jasmonate
Isocaryophyllene	0.02	Sesquiterpene
$\beta$ -Caryophyllene	1.47	Sesquiterpene
$\beta$ -Ylangene	0.07	Sesquiterpene
$\beta$ -Copaene	0.03	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.01	Sesquiterpene
Isogermacrene D	0.01	Sesquiterpene
$\alpha$ -Humulene	0.07	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.19	Sesquiterpene
9-epi- $\beta$ -Caryophyllene	0.01	Sesquiterpene
Germacrene D	0.90	Sesquiterpene
Menthylactone	0.03	Monoterpenic lactone
Viridiflorene	0.03	Sesquiterpene
Bicyclogermacrene	0.10	Sesquiterpene
$\alpha$ -Muurolene	0.02	Sesquiterpene
$\gamma$ -Cadinene	0.02	Sesquiterpene

$\delta$ -Cadinene	0.04	Sesquiterpene
<i>trans</i> -Calamenene	0.01	Sesquiterpene
Spathulenol	0.01	Sesquiterpenic alcohol
Caryophyllene oxide	0.04	Sesquiterpenic ether
Viridiflorol	0.08	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.01	Sesquiterpenic alcohol
Mint sulfide?	0.01	Sesquiterpenic sulfide
<b>Consolidated total</b>	<b>98.79%</b>	

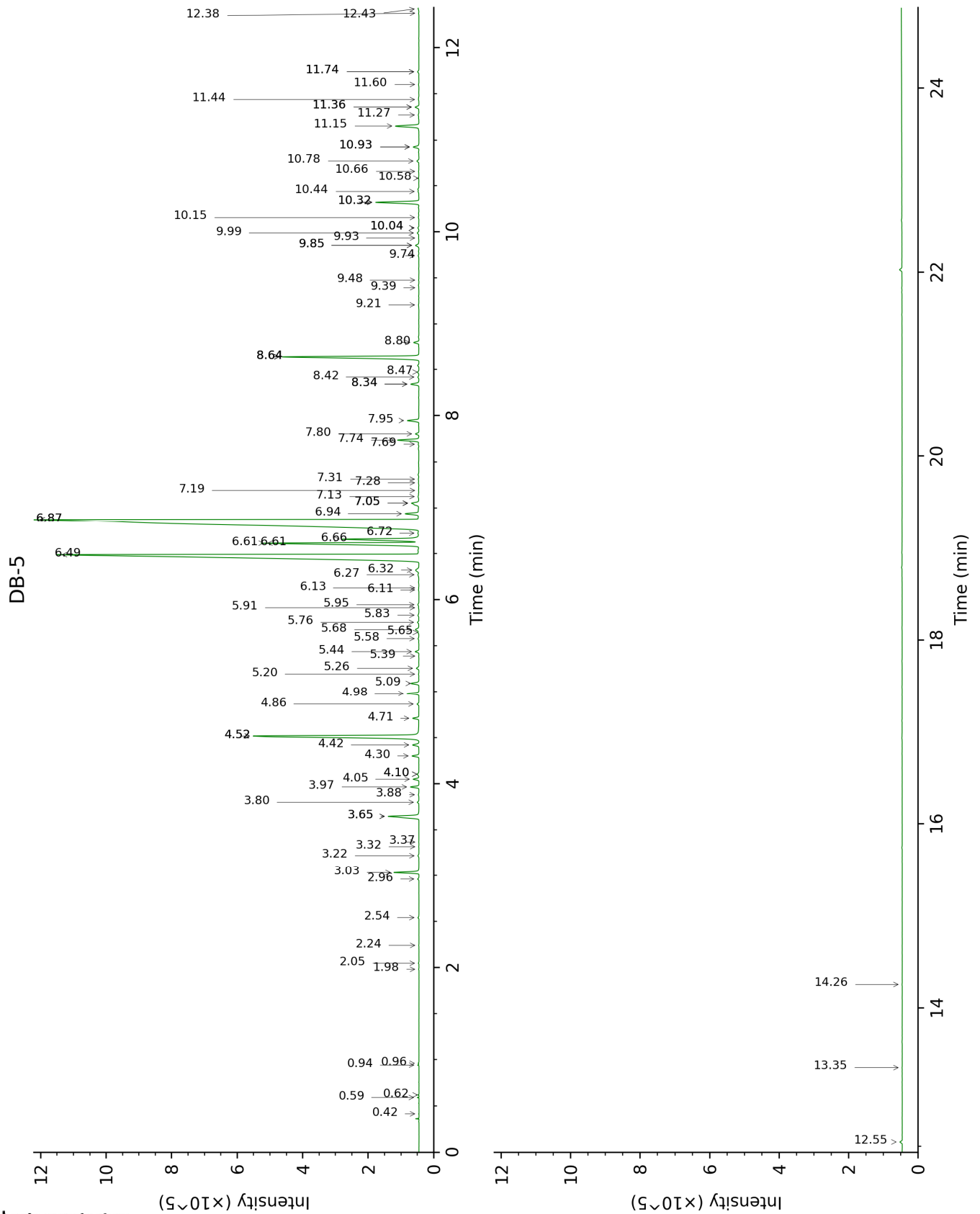
tr: The compound has been detected below 0.005% of total signal.

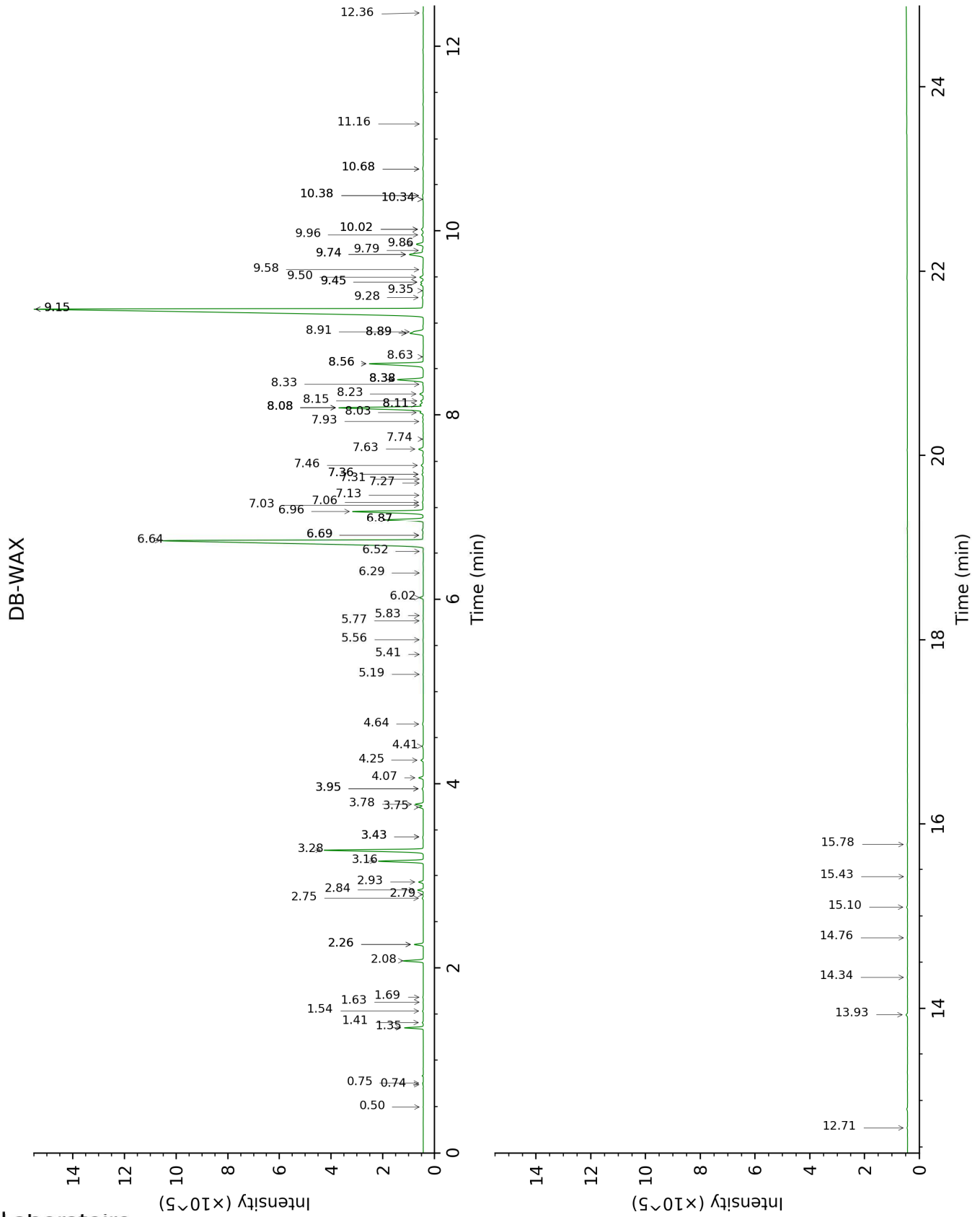
Note: no correction factor was applied

**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	%
Isobutyral	0.42	538	tr	0.50	782	tr
Isovaleral	0.59	639	0.02	0.75	886	0.02
2-Methylbutyral	0.62	651	0.01	0.74	880	0.01
Isoamyl alcohol	0.94	736	0.02	3.43*	1179	0.05
2-Methylbutanol	0.96	739	0.01	3.43*	1179	[0.05]
Ethyl 2-methylbutyrate	1.98	851	0.01	1.63	1022	0.01
(3Z)-Hexenol	2.05	856	0.02	5.83	1354	0.01
Hexanol	2.24	872	0.01	5.41	1324	0.01
<i>trans</i> -2,5-Diethyltetrahydrofuran	2.54	897	0.03	1.54	1013	0.03
$\alpha$ -Thujene	2.96	926	0.04	1.41	1001	0.04
$\alpha$ -Pinene	3.03	930	0.73	1.36	991	0.74
Camphene	3.22	942	0.04	1.68	1028	0.02
Thuja-2,4(10)-diene	3.32	949	tr	2.26*	1084	0.40
Benzaldehyde	3.37	952	tr	7.31	1464	0.01
$\beta$ -Pinene	3.65*	971	1.31	2.08	1066	0.93
Sabinene	3.65*	971	[1.31]	2.26*	1084	[0.40]
Octen-3-ol	3.80	981	0.05	6.69*	1418	0.07
Octan-3-one	3.88	986	0.02	3.95*	1219	0.08
Myrcene	3.97	992	0.25	2.84	1134	0.26
Octan-3-ol	4.05	997	0.18	6.02	1368	0.18
$\alpha$ -Phellandrene	4.10*	1001	0.07	2.76	1127	0.05
Pseudolimonene	4.10*	1001	[0.07]	2.80	1130	0.02
$\alpha$ -Terpinene	4.30	1013	0.22	2.93	1140	0.22
para-Cymene	4.42	1021	0.22	4.06	1228	0.23
Limonene	4.52*	1027	7.61	3.16	1159	2.23
1,8-Cineole	4.52*	1027	[7.61]	3.28	1168	5.46
(Z)- $\beta$ -Ocimene	4.71	1039	0.18	3.75†	1204	0.59
(E)- $\beta$ -Ocimene	4.86	1049	0.06	3.95*	1219	[0.08]
$\gamma$ -Terpinene	4.98	1056	0.38	3.78†	1207	[0.59]
<i>cis</i> -Sabinene hydrate	5.09	1063	0.27	6.87*	1430	2.16
<i>cis</i> -Linalool oxide (fur.)	5.20	1070	0.01	6.52	1404	0.02
Octanol	5.26	1074	0.09	8.15	1528	0.15
para-Cymenene	5.39	1082	tr	6.29	1388	0.01
Terpinolene	5.44	1085	0.12	4.26	1242	0.12
<i>trans</i> -Sabinene hydrate	5.58	1094	0.03	7.93	1510	0.04
Nonan-3-ol	5.65	1098	0.03	7.27	1460	0.03
Linalool	5.68	1100	0.16	8.03	1518	0.16
2-Methylbutyl 2-methylbutyrate	5.76	1105	0.05	4.41	1253	0.06
Amyl isovalerate	5.83	1110	0.04	4.64	1270	0.06
Octen-3-yl acetate	5.91	1116	0.01	5.77	1350	0.02
<i>cis</i> -para-Menth-2-en-1-ol	5.95	1118	0.05	8.08*†	1522	5.51
Octan-3-yl acetate	6.11	1128	0.01	5.19	1308	0.01
allo-Ocimene	6.13	1130	0.01	5.56	1335	0.02
<i>trans</i> -Sabinol	6.27	1139	0.06	9.79	1657	0.07

Isopulegol	6.32	1142	0.19	8.11*†	1524	[5.51]
Menthone	6.49	1153	24.75	6.64	1413	24.68
Isomenthone	6.61*	1161	6.00	6.96	1437	4.12
Menthofuran	6.61*	1161	[6.00]	6.87*	1430	[2.16]
neo-Menthol	6.66	1164	2.90	8.56*	1559	3.53
δ-Terpineol	6.72	1168	0.05	9.45*†	1629	0.26
Terpinen-4-ol	6.87*	1178	41.21	8.56*	1559	[3.53]
Menthol	6.87*	1178	[41.21]	9.15*	1606	40.24
Isomenthol	6.94	1182	0.53	8.89*†	1585	1.20
α-Terpineol	7.05*	1190	0.39	9.74*	1654	1.00
Myrtenal	7.05*	1190	[0.39]	8.63	1565	0.02
neoiso-Menthol	7.05*	1190	[0.39]	9.45*†	1629	[0.26]
Methylchavicol	7.13	1195	0.04	9.28	1616	0.05
trans-Isopiperitenol	7.19	1199	0.01	10.38*	1706	0.06
Unknown [m/z 43, 99 (84), 81 (46), 986 (43), 126 (36), 71 (28)... 170 (12)]	7.28	1204	0.01			
trans-Piperitol	7.31	1207	0.02	10.34*	1702	0.03
Citronellol	7.69	1233	0.02	10.68*	1731	0.05
Pulegone	7.74	1236	0.72	8.89*†	1585	[1.20]
Carvone	7.80	1241	0.11	9.96	1671	0.09
Piperitone	7.95	1251	0.39	9.86	1663	0.40
Decanol	8.34*	1278	0.29	10.68*	1731	[0.05]
neo-Menthyl acetate	8.34*	1278	[0.29]	7.63	1488	0.27
2-Ethylmenthone?	8.42	1284	0.04			
Dihydroedulan I	8.47	1288	0.05	7.06	1445	0.08
Menthyl acetate	8.64*	1299	5.34	8.08*†	1522	[5.51]
Dihydroedulan II	8.64*	1299	[5.34]	7.36*	1467	0.08
Thymol	8.64*	1299	[5.34]	15.10	2135	0.05
Isomenthyl acetate	8.80	1305	0.18	8.23	1533	0.21
Bicycloelemene	9.21	1334	0.03	7.03	1442	0.04
α-Cubebene	9.40	1347	0.01	6.69*	1418	[0.07]
Eugenol	9.48	1353	0.01	14.76	2102	0.02
α-Copaene	9.74	1372	0.03	7.13	1450	0.04
β-Bourbonene	9.85*	1380	0.15	7.46	1474	0.13
1,5-diepi-β-Bourbonene	9.85*	1380	[0.15]	7.36*	1467	[0.08]
β-Cubebene	9.93	1385	0.01	7.74	1496	0.01
β-Elemene	9.99	1389	0.06	8.38*	1545	1.55
Unknown [m/z 107, 121 (79), 119 (66), 91 (58), 136 (55), 105 (49)... 194 (1)]	10.04*	1393	0.04			
(Z)-Jasmone	10.04*	1393	[0.04]	12.36	1877	0.02
Isocaryophyllene	10.16	1401	0.02	8.11*†	1524	[5.51]
β-Caryophyllene	10.32*	1413	1.54	8.38*	1545	[1.55]
β-Ylangene	10.32*	1413	[1.54]	8.08*†	1522	[5.51]
β-Copaene	10.44	1422	0.03	8.33	1542	0.03
trans-α-Bergamotene	10.58	1433	0.01	8.38*	1545	[1.55]
Isogermacrene D	10.66	1439	0.01	8.91†	1586	[1.20]
α-Humulene	10.78	1447	0.07	9.15*	1606	[40.24]

(E)-β-Farnesene	10.93*	1459	0.21	9.50	1634	0.19
9-epi-β-Caryophyllene	10.93*	1459	[0.21]	9.35	1622	0.01
Germacrene D	11.15	1476	0.90	9.74*	1654	[1.00]
Menthylactone	11.27	1484	0.03	15.78	2204	0.04
Viridiflorene	11.36*	1491	0.14	9.58	1640	0.03
Bicyclogermacrene	11.36*	1491	[0.14]	10.02*	1676	0.12
α-Muurolene	11.44	1497	0.02	10.02*	1676	[0.12]
γ-Cadinene	11.60	1509	0.02	10.34*	1702	[0.03]
δ-Cadinene	11.74*	1520	0.05	10.38*	1706	[0.06]
trans-Calamenene	11.74*	1520	[0.05]	11.16	1772	0.01
Spathulenol	12.38	1570	0.01	14.34	2061	0.02
Caryophyllene oxide	12.43	1574	0.04	12.71	1908	0.03
Viridiflorol	12.55	1584	0.08	13.93	2022	0.08
α-Cadinol	13.35	1649	0.01	15.43	2168	0.01
Mint sulfide?	14.26	1725	0.01			
<b>Total identified</b>		<b>99.26%</b>			<b>98.89%</b>	
<b>Total reported</b>		<b>99.28%</b>			<b>98.89%</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