

Date : 2026-01-05

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 25L16-PTH04

Customer Identification : Black Pepper ORGANIC - Sri Lanka - BS0111R

Type : Essential Oil

Source : *Piper nigrum*

Customer : Plant Therapy

Checked and approved by:

Alexis St-Gelais, Ph. D., 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Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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. The compliance status of the sample is provided to facilitate the reading of the report. The client remains ultimately responsible for reviewing the results presented within this report and to establish compliance of the tested batch against relevant quality criteria.

This report is an update from the first version issued on 2025-12-18 to correct the customer identification.

GAS CHROMATOGRAPHIC ANALYSIS

Method : PC-MAT-014 - Analysis of the composition of an essential oil or other volatile liquide by FAST GC-FID

✖ISO

Results : See analysis summary (next page)

Analyst : Sylvain Mercier, M. Sc., Chimiste 2014-005

Date : 2025-12-16

PHYSICOCHEMICAL DATA

Refractive index : 1.478 ± 0.0003 (20 °C)

Method : PC-MAT-016 - Measure of the refractive index of a liquid.

Analyst : Cindy Caron B. Sc.

Date : 2025-12-16

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	tr	Aliphatic aldehyde
Toluene	0.01	Simple phenolic
Tricyclene	0.02	Monoterpene
α -Thujene	1.95	Monoterpene
α -Pinene	15.37	Monoterpene
α -Fenchene	0.01	Monoterpene
Camphene	0.37	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.02	Monoterpene
Sabinene	15.35	Monoterpene
β -Pinene	11.34	Monoterpene
Myrcene	2.00	Monoterpene
2-Carene	0.02	Monoterpene
Pseudolimonene	0.04	Monoterpene
α -Phellandrene	3.41	Monoterpene
Δ^3 -Carene	6.79	Monoterpene
α -Terpinene	0.13	Monoterpene
Carvomenthene	tr	Aliphatic alcohol
<i>meta</i> -Cymene	0.02	Monoterpene
<i>para</i> -Cymene	0.54	Monoterpene
β -Phellandrene	[2.20]	Monoterpene
1,8-Cineole	[2.20]	Monoterpenic ether
Limonene	14.72	Monoterpene
(Z)- β -Ocimene	0.03	Monoterpene
(E)- β -Ocimene	0.18	Monoterpene
Unknown	0.02	Monoterpene
γ -Terpinene	0.18	Monoterpene
<i>cis</i> -Sabinene hydrate	0.08	Monoterpenic alcohol
Isoterpinolene	0.09	Monoterpene
<i>para</i> -Cymenene	0.02	Monoterpene
Terpinolene	0.31	Monoterpene
<i>trans</i> -Sabinene hydrate	0.05	Monoterpenic alcohol
Linalool	0.21	Monoterpenic alcohol
Verbenol analog?	0.01	Monoterpenic alcohol
<i>trans-para</i> -Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
<i>cis-para</i> -Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
<i>trans-para</i> -Menth-2-en-1-ol	0.02	Monoterpenic alcohol
<i>trans</i> -Verbenol	0.01	Monoterpenic alcohol
<i>meta</i> -Mentha-4,6-dien-8-ol	tr	Monoterpenic alcohol
Pinocarvone	0.03	Monoterpenic ketone
<i>cis</i> -Sabinol	0.02	Monoterpenic alcohol

Terpinen-4-ol	0.25	Monoterpenic alcohol
<i>meta</i> -Cymen-8-ol	0.01	Monoterpenic alcohol
Cryptone	0.02	Normoterpenic ketone
<i>para</i> -Cymen-8-ol	0.02	Monoterpenic alcohol
α -Terpineol	0.05	Monoterpenic alcohol
Myrtenol	0.02	Monoterpenic alcohol
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	0.03	Monoterpenic ether
Verbenone	0.02	Monoterpenic ketone
Car-2-en-4-one?	0.01	Monoterpenic ketone
<i>trans</i> -Carveol	0.02	Monoterpenic alcohol
Nerol	0.02	Monoterpenic alcohol
Cuminal	0.01	Monoterpenic aldehyde
Carvone	0.01	Monoterpenic ketone
Unknown	0.03	Unknown
Methyl citronellate	0.01	Monoterpenic ester
Bornyl acetate	0.02	Monoterpenic ester
Car-3-en-5-one	0.03	Monoterpenic ketone
Bicycloelemene	0.01	Sesquiterpene
δ -Elemene isomer	0.01	Sesquiterpene
δ -Elemene	0.62	Sesquiterpene
α -Cubebene	0.11	Sesquiterpene
Cyclosativene I	0.06	Sesquiterpene
Cyclosativene II	0.02	Sesquiterpene
α -Copaene	1.84	Sesquiterpene
<i>cis</i> - β -Elemene	0.02	Sesquiterpene
β -Cubebene	0.20	Sesquiterpene
β -Elemene	0.15	Sesquiterpene
Isocaryophyllene	0.02	Sesquiterpene
α -Gurjunene	0.05	Sesquiterpene
β -Caryophyllene	16.44	Sesquiterpene
β -Copaene	0.10	Sesquiterpene
α -Guaiene	[0.03]	Sesquiterpene
<i>trans</i> - α -Bergamotene	[0.03]	Sesquiterpene
α -Humulene	0.65	Sesquiterpene
allo-Aromadendrene	0.01	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.09	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.01	Sesquiterpene
γ -Murolene	0.05	Sesquiterpene
Germacrene D	0.15	Sesquiterpene
α -Curcumene	0.03	Sesquiterpene
β -Selinene	0.06	Sesquiterpene
<i>trans</i> -Muurolo-4(15),5-diene	0.02	Sesquiterpene
α -Selinene	0.06	Sesquiterpene
epi-Cubebol	0.05	Sesquiterpenic alcohol
Bicyclogermacrene	0.08	Sesquiterpene

α -Muurolene	0.12	Sesquiterpene
Germacrene A	0.08	Sesquiterpene
β -Bisabolene	0.82	Sesquiterpene
Cubebol	0.10	Sesquiterpenic alcohol
7-epi- α -Selinene	0.02	Sesquiterpene
δ -Cadinene	0.43	Sesquiterpene
<i>trans</i> -Calamenene	0.03	Sesquiterpene
(<i>E</i>)- γ -Bisabolene	0.02	Sesquiterpene
(<i>E</i>)- α -Bisabolene	0.02	Sesquiterpene
Isocaryophyllene epoxide B	0.03	Sesquiterpenic ether
Germacrene B	0.01	Sesquiterpene
(<i>E</i>)-Nerolidol	0.03	Sesquiterpenic alcohol
Spathulenol	0.04	Sesquiterpenic alcohol
Caryophyllene oxide	0.35	Sesquiterpenic ether
Caryophyllene oxide isomer	0.09	Sesquiterpenic ether
Humulene epoxide II	0.02	Sesquiterpenic ether
Alismol	0.12	Sesquiterpenic alcohol
Caryophylladienol II	0.02	Sesquiterpenic alcohol
τ -Muurolol	0.02	Sesquiterpenic alcohol
α -Muurolol	0.08	Sesquiterpenic alcohol
<i>meta</i> -Camphorene	0.03	Diterpene
<i>para</i> -Camphorene	0.02	Diterpene
Consolidated total	99.65	

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

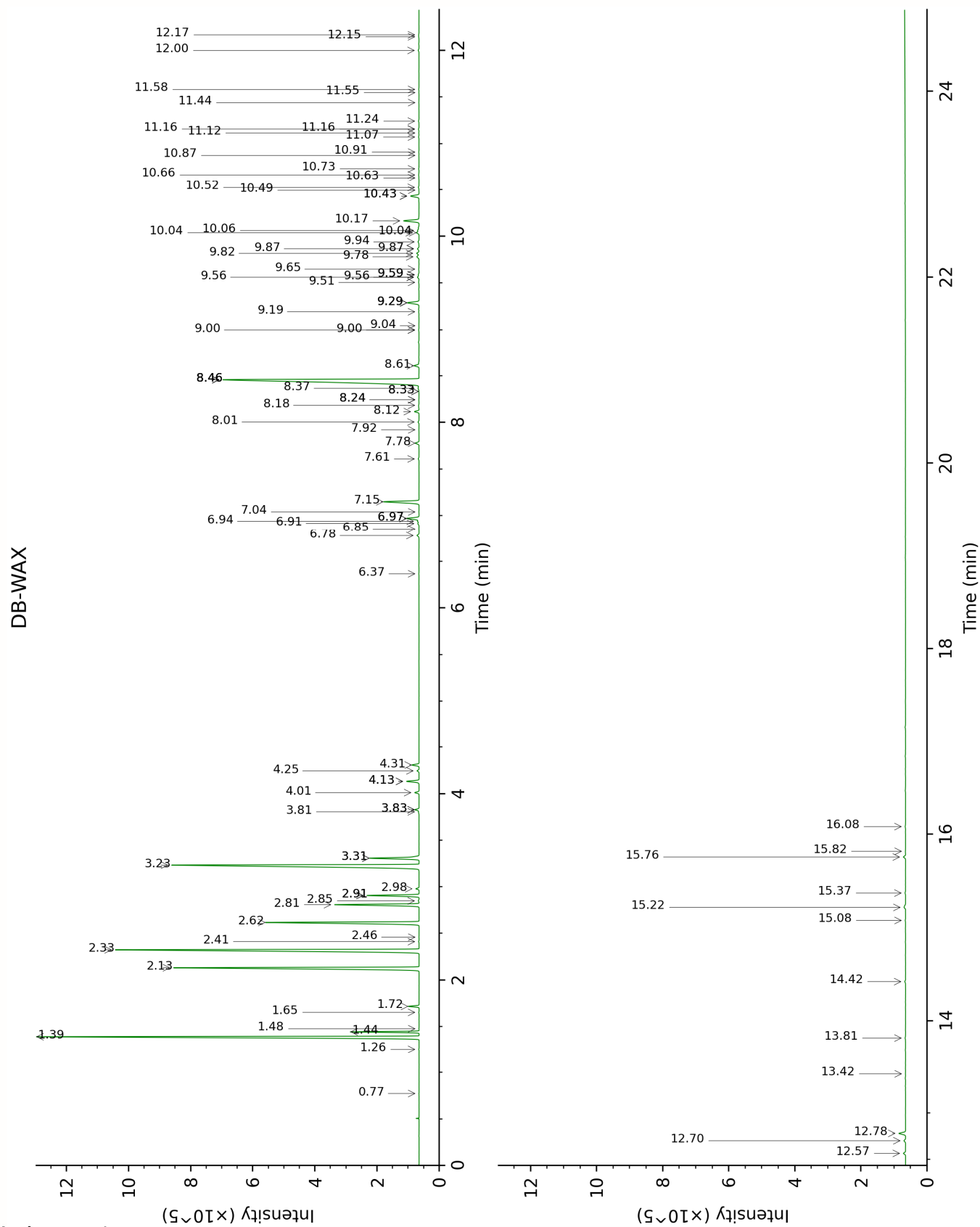
Note: no correction factor was applied

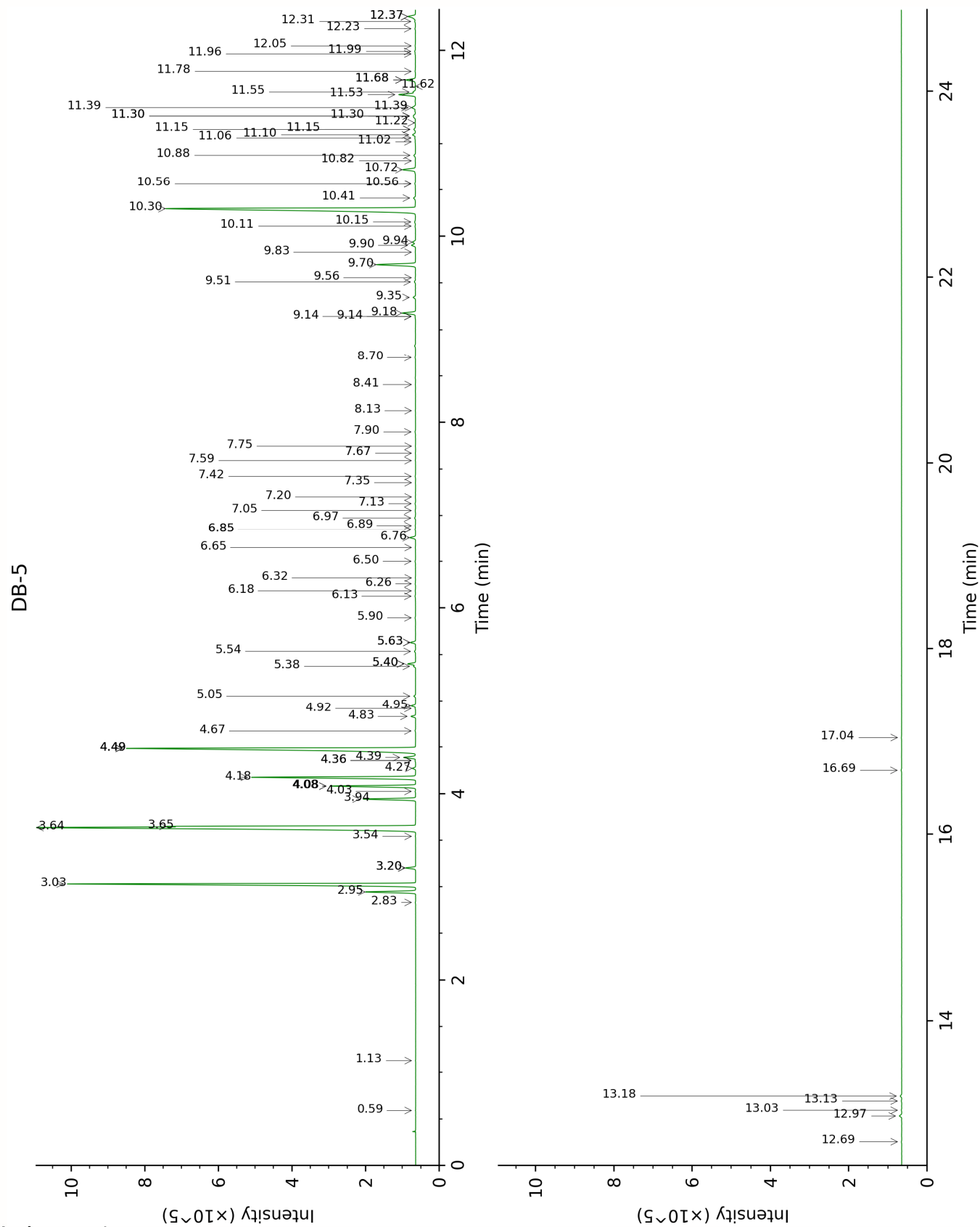
About "consolidated" data: The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm 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.

Bracketed value ([xx]): A bracketed percent value indicate that two or more compound percentage could not be solved due to coelution.

This page was intentionally left blank. The following pages present the complete data of the analysis.





FULL ANALYSIS DATA

Isovaleral	Column DB-WAX			Column DB-5		
	0.77	887.7	tr	0.59	643.1	tr
Toluene	1.48	1001.9	0.01	1.13	759.3	0.01
Tricyclene	1.26	970.3	0.01	2.83	919.1	0.02
α -Thujene	1.44	998.6	1.93	2.95	926.6	1.95
α -Pinene	1.39	992.5	15.35	3.03	932.3	15.37
α -Fenchene	1.65	1019.3	0.01	3.20*	943.8	[0.39]
Camphene	1.72	1025.7	0.37	3.20*	943.8	[0.39]
3,7,7-Trimethylcyclohepta-1,3,5-triene	2.91*	1133.9	[2.01]	3.54	966.6	0.02
Sabinene	2.32	1086.2	15.35	3.64*†	972.9	[21.84]
β -Pinene	2.13	1066.9	11.34	3.65*†	973.8	[4.95]
Myrcene	2.91*	1133.9	[2.01]	3.94	993.5	2.00
2-Carene	2.41	1094.9	0.02	4.02	999.0	0.02
Pseudolimonene	2.85	1129.4	0.04	4.08*	1002.8	[3.43]
α -Phellandrene	2.81	1126.2	3.41	4.08*	1002.8	[3.43]
Δ^3 -Carene	2.62	1111.2	6.78	4.18	1008.9	6.79
α -Terpinene	2.98	1139.6	0.13	4.27	1015.0	0.13
Carvomenthene	2.46	1098.7	tr	4.36*	1020.3	[0.03]
meta-Cymene	4.13*	1228.3	[0.57]	4.36*	1020.3	[0.03]
para-Cymene	4.13*	1228.3	[0.57]	4.39	1022.4	0.54
β -Phellandrene	3.31*	1165.5	[2.17]	4.49*	1028.6	[16.92]
1,8-Cineole	3.31*	1165.5	[2.17]	4.49*	1028.6	[16.92]
Limonene	3.23	1159.6	14.72	4.49*	1028.6	[16.92]
(Z)- β -Ocimene	3.81	1204.3	0.04	4.67	1040.4	0.03
(E)- β -Ocimene	4.01	1219.4	0.18	4.83	1050.4	0.18
Unknown CUSE I [m/z 93, 91 (54), 92 (31), 77 (29), 79 (17), 43 (13), 41 (10), 136 (9)]	3.83*	1205.9	[0.18]	4.92	1055.8	0.02
γ -Terpinene	3.83*	1205.9	[0.18]	4.94	1057.6	0.18
cis-Sabinene hydrate	6.94	1429.7	0.07	5.05	1064.6	0.08
Isoterpinolene	4.25	1236.6	0.09	5.38	1085.0	0.09
para-Cymenene	6.37	1387.9	0.02	5.40*	1086.7	[0.32]
Terpinolene	4.31	1241.2	0.31	5.40*	1086.7	[0.32]
trans-Sabinene hydrate	8.01	1508.7	0.05	5.54	1095.2	0.05
Linalool	8.12	1517.2	0.21	5.63*	1101.3	[0.21]
Verbenol analog?	8.33*	1533.8	[0.02]	5.63*	1101.3	[0.21]
trans-para-Mentha-2,8-dien-1-ol	9.00*	1585.0	[0.03]	5.90	1118.4	0.03
cis-para-Mentha-2,8-	9.51	1625.6	0.03	6.13	1133.4	0.03

dien-1-ol						
<i>trans-para</i> -Menth-2-en-1-ol	9.04	1588.5	0.01	6.18	1137.1	0.02
<i>trans</i> -Verbenol	9.56*†	1630.0	[0.09]	6.26	1142.1	0.01
<i>meta</i> -Mentha-4,6-dien-8-ol	9.29*	1608.0	[0.63]	6.32	1146.1	tr
Pinocarvone	7.92	1502.2	0.01	6.50	1157.7	0.03
<i>cis</i> -Sabinol	10.91	1740.5	0.01	6.65	1167.3	0.02
Terpinen-4-ol	8.61	1555.0	0.25	6.76	1174.2	0.25
<i>meta</i> -Cymen-8-ol	11.55	1794.4	0.01	6.85*	1180.1	[0.03]
Cryptone	9.19	1600.3	0.02	6.85*	1180.1	[0.03]
<i>para</i> -Cymen-8-ol	11.58	1797.4	0.02	6.89	1182.9	0.02
α -Terpineol	9.82	1650.6	0.13	6.97	1188.3	0.05
Myrtenol	10.87	1737.5	0.01	7.05	1193.5	0.02
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	11.07	1754.1	0.03	7.13	1198.4	0.03
Verbenone	9.65	1637.0	0.03	7.20	1203.1	0.02
Car-2-en-4-one?	9.59*†	1632.2	[0.04]	7.35	1213.4	0.01
<i>trans</i> -Carveol	11.44	1785.2	0.01	7.42	1217.9	0.02
Nerol	11.12	1757.8	0.02	7.59	1229.5	0.02
Cuminal	10.63	1717.2	0.01	7.67	1234.9	0.01
Carvone	10.04*	1668.3	[0.13]	7.75	1240.1	0.01
Unknown CALU IV [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	11.16*	1761.3	[0.03]	7.90	1250.6	0.03
Methyl citronellate	8.24*	1527.0	[0.02]	8.13	1266.1	0.01
Bornyl acetate	8.24*	1527.0	[0.02]	8.41	1285.3	0.02
Car-3-en-5-one	12.17	1849.0	0.02	8.70	1305.3	0.03
Bicycloelemene	7.04	1437.0	0.01	9.14*	1332.8	[0.03]
δ -Elemene isomer	6.85	1423.4	0.01	9.14*	1332.8	[0.03]
δ -Elemene	6.97*	1431.8	[0.63]	9.18	1335.4	0.62
α -Cubebene	6.78	1417.9	0.11	9.35	1347.3	0.11
Cyclosativene I	6.91	1427.8	0.07	9.51	1359.0	0.06
Cyclosativene II	6.97*	1431.8	[0.63]	9.56	1362.3	0.02
α -Copaene	7.15	1445.1	1.84	9.70	1372.3	1.84
<i>cis</i> - β -Elemene	8.33*	1533.8	[0.02]	9.83	1381.7	0.02
β -Cubebene	7.78	1491.3	0.19	9.90	1386.9	0.20
β -Elemene	8.46*	1543.5	[16.70]	9.94	1389.4	0.15
Isocaryophyllene	8.18	1522.4	0.04	10.11	1401.6	0.02
α -Gurjunene	7.61	1478.9	0.04	10.15	1404.8	0.05
β -Caryophyllene	8.46*	1543.5	[16.70]	10.30	1415.5	16.44
β -Copaene	8.37	1536.5	0.08	10.41	1424.0	0.10
α -Guaiene	8.46*	1543.5	[16.70]	10.56*	1435.5	[0.03]
<i>trans</i> - α -	8.46*	1543.5	[16.70]	10.56*	1435.5	[0.03]

Bergamotene						
α -Humulene	9.29*	1608.0	[0.63]	10.72	1447.3	0.65
allo-Aromadendrene	9.00*	1585.0	[0.03]	10.82	1454.4	0.01
(E)- β -Farnesene	9.56*†	1630.0	[0.09]	10.88	1458.9	0.09
trans-Cadina-1(6),4-diene	9.29*	1608.0	[0.63]	11.02	1469.8	0.01
γ -Murolene	9.59*†	1632.2	[0.04]	11.06	1472.9	0.05
Germacrene D	9.78	1647.6	0.14	11.10	1475.4	0.15
α -Curcumene	10.66	1719.8	0.03	11.15*	1479.8	[0.09]
β -Selinene	9.87*	1654.5	[0.09]	11.15*	1479.8	[0.09]
trans-Murola-4(15),5-diene	9.87*	1654.5	[0.09]	11.22	1485.1	0.02
α -Selinene	9.94	1660.5	0.06	11.30*	1490.5	[0.18]
epi-Cubebol	12.00	1834.2	0.05	11.30*	1490.5	[0.18]
Bicyclogermacrene	10.06	1670.2	0.08	11.30*	1490.5	[0.18]
α -Murolene	10.04*	1668.3	[0.13]	11.39*	1497.3	[0.20]
Germacrene A	10.43*	1700.2	[0.43]	11.39*	1497.3	[0.20]
β -Bisabolene	10.17	1678.5	0.79	11.53	1508.0	0.82
Cubebol	12.57	1884.1	0.11	11.55	1510.1	0.10
7-epi- α -Selinene	10.49	1705.5	tr	11.62	1515.2	0.02
δ -Cadinene	10.43*	1700.2	[0.43]	11.68*	1520.4	[0.46]
trans-Calamenene	11.24	1768.5	0.03	11.68*	1520.4	[0.46]
(E)- γ -Bisabolene	10.52	1708.1	0.04	11.78	1527.7	0.02
(E)- α -Bisabolene	10.73	1725.4	0.02	11.96	1542.5	0.02
Isocaryophyllene epoxide B	12.15	1847.1	0.02	11.99	1544.6	0.03
Germacrene B	11.16*	1761.3	[0.03]	12.05	1549.3	0.01
(E)-Nerolidol	13.81	1998.8	0.03	12.23	1563.9	0.03
Spathulenol	14.42	2056.9	0.04	12.31	1570.0	0.04
Caryophyllene oxide	12.78	1903.6	0.35	12.37*	1574.3	[0.44]
Caryophyllene oxide isomer	12.70	1896.3	0.09	12.37*	1574.3	[0.44]
Humulene epoxide II	13.42	1962.4	0.01	12.69	1600.1	0.02
Alismol	15.76	2189.3	0.11	12.97	1622.8	0.12
Caryophylladienol II	16.08	2223.2	0.03	13.03	1628.0	0.02
τ -Murolol	15.08	2121.2	0.02	13.13	1636.2	0.02
α -Murolol	15.22	2135.2	0.11	13.18	1640.6	0.08
meta-Camphorene	15.37	2150.6	0.03	16.69	1951.2	0.03
para-Camphorene	15.82	2195.7	0.01	17.04	1984.7	0.02
Total reported		99.40%			99.75%	

*: Two or more compounds are coeluting on this column

[xx]: Duplicate percentage due to coelutions, only the first one is 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