

Date : 2024-04-15

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 24C28-PTH04

Customer Identification : Organic Black Pepper - India - BS0109R

Type : Essential Oil

Source : *Piper nigrum*

Customer : Plant Therapy

Checked and approved by:

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

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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 : Benoit Roger, Ph. D.

Date : 2024-04-12

PHYSICOCHEMICAL DATA

Refractive index : 1.4844 ± 0.0003 (20 °C)

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

Analyst : Cindy Caron B. Sc.

Date : 2024-03-28

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
Toluene	0.01	Simple phenolic
Tricyclene	0.04	Monoterpene
α -Thujene	0.99	Monoterpene
α -Pinene	12.41	Monoterpene
α -Fenchene	0.02	Monoterpene
Camphene	0.38	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.04	Monoterpene
Sabinene	10.71	Monoterpene
β -Pinene	9.98	Monoterpene
Dehydro-1,8-cineole	0.01	Monoterpenic ether
Myrcene	1.15	Monoterpene
2-Carene	0.01	Monoterpene
Pseudolimonene	0.05	Monoterpene
α -Phellandrene	0.21	Monoterpene
Δ^3 -Carene	5.37	Monoterpene
α -Terpinene	0.02	Monoterpene
<i>meta</i> -Cymene	0.04	Monoterpene
<i>para</i> -Cymene	1.11	Monoterpene
β -Phellandrene	0.77	Monoterpene
1,8-Cineole	0.06	Monoterpenic ether
Limonene	12.63	Monoterpene
(<i>Z</i>)- β -Ocimene	0.01	Monoterpene
(<i>E</i>)- β -Ocimene	0.03	Monoterpene
γ -Terpinene	0.02	Monoterpene
<i>cis</i> -Sabinene hydrate	0.14	Monoterpenic alcohol
Isoterpinolene	0.04	Monoterpene
<i>para</i> -Cymenene	0.02	Monoterpene
Terpinolene	0.10	Monoterpene
α -Pinene oxide	0.04	Monoterpenic ether
<i>trans</i> -Sabinene hydrate	0.09	Monoterpenic alcohol
Unknown	0.03	Unknown
Linalool	0.40	Monoterpenic alcohol
Unknown	0.02	Unknown
<i>trans-para</i> -Mentha-2,8-dien-1-ol	0.05	Monoterpenic alcohol
<i>cis</i> -Limonene oxide	0.04	Monoterpenic ether
<i>cis-para</i> -Mentha-2,8-dien-1-ol	0.07	Monoterpenic alcohol
<i>trans</i> -Limonene oxide	0.01	Monoterpenic ether
<i>trans-para</i> -Menth-2-en-1-ol	0.01	Monoterpenic alcohol
<i>trans</i> -Verbenol	0.05	Monoterpenic alcohol
<i>meta</i> -Mentha-4,6-dien-8-ol	0.01	Monoterpenic alcohol

Pinocarvone	0.02	Monoterpenic ketone
<i>cis</i> -Sabinol	0.01	Monoterpenic alcohol
Terpinen-4-ol	0.27	Monoterpenic alcohol
<i>meta</i> -Cymen-8-ol	0.05	Monoterpenic alcohol
Unknown	0.07	Unknown
α -Terpineol	0.12	Monoterpenic alcohol
Myrtenal	0.10	Monoterpenic aldehyde
Myrtenol	0.07	Monoterpenic alcohol
<i>trans</i> -Isopiperitenol	0.01	Monoterpenic alcohol
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	0.03	Monoterpenic ether
Unknown	0.02	Oxygenated monoterpene
Verbenone	0.10	Monoterpenic ketone
Car-2-en-4-one?	0.02	Monoterpenic ketone
<i>trans</i> -Carveol	0.05	Monoterpenic alcohol
<i>cis</i> -Carveol	0.03	Monoterpenic alcohol
Cuminal	0.02	Monoterpenic aldehyde
Carvone	0.02	Monoterpenic ketone
Unknown	0.03	Unknown
Car-3-en-5-one	0.07	Monoterpenic ketone
<i>para</i> -Menth-5-en-1,2-diol isomer II	0.01	Monoterpenic alcohol
<i>para</i> -Menth-5-en-1,2-diol isomer III	0.07	Monoterpenic alcohol
δ -Elemene isomer	0.03	Sesquiterpene
δ -Elemene	1.28	Sesquiterpene
Bicycloelemene	0.02	Sesquiterpene
α -Cubebene	0.18	Sesquiterpene
Cyclosativene I	0.08	Sesquiterpene
Cyclosativene II	0.03	Sesquiterpene
α -Copaene	3.00	Sesquiterpene
β -Cubebene	0.27	Sesquiterpene
β -Elemene	0.36	Sesquiterpene
Isocaryophyllene	0.05	Sesquiterpene
α -Gurjunene	0.10	Sesquiterpene
<i>cis</i> - α -Bergamotene	0.10	Sesquiterpene
β -Caryophyllene	24.31	Sesquiterpene
β -Copaene	0.13	Sesquiterpene
α -Guaiene	[0.05]	Sesquiterpene
<i>trans</i> - α -Bergamotene	[0.05]	Sesquiterpene
α -Humulene	1.24	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.11	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.01	Sesquiterpene
γ -Murolene	0.06	Sesquiterpene
Germacrene D	0.13	Sesquiterpene
β -Selinene	0.38	Sesquiterpene
α -Selinene	0.01	Sesquiterpene
Viridiflorene	0.09	Sesquiterpene

epi-Cubebol	0.12	Sesquiterpenic alcohol
α -Muurolene	0.25	Sesquiterpene
β -Bisabolene	1.17	Sesquiterpene
Cubebol	0.15	Sesquiterpenic alcohol
<i>trans</i> -Calamenene	0.09	Sesquiterpene
δ -Cadinene	0.69	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.01	Sesquiterpene
(<i>E</i>)- γ -Bisabolene	0.01	Sesquiterpene
α -Calacorene	0.06	Sesquiterpene
(<i>E</i>)- α -Bisabolene	0.05	Sesquiterpene
Isocaryophyllene epoxide B	0.32	Sesquiterpenic ether
Germacrene B	0.07	Sesquiterpene
(<i>E</i>)-Nerolidol	0.03	Sesquiterpenic alcohol
Spathulenol	0.04	Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.78	Sesquiterpenic ether
Caryophyllene oxide	3.23	Sesquiterpenic ether
Humulene epoxide I	0.04	Sesquiterpenic ether
Humulene epoxide II	0.16	Sesquiterpenic ether
α -Corocalene	0.02	Sesquiterpene
Alismol	0.31	Sesquiterpenic alcohol
Caryophylladienol II	0.14	Sesquiterpenic alcohol
τ -Muurolol	0.02	Sesquiterpenic alcohol
τ -Cadinol	0.01	Sesquiterpenic alcohol
α -Muurolol	0.09	Sesquiterpenic alcohol
<i>cis</i> -Calamenen-10-ol	0.03	Sesquiterpenic alcohol
<i>trans</i> -Calamenen-10-ol	0.01	Sesquiterpenic alcohol
(3 <i>Z</i>)-Caryophylla-3,8(13)-dien-5 β -ol	0.02	Sesquiterpenic alcohol
<i>meta</i> -Camphorene	0.05	Diterpene
<i>para</i> -Camphorene	0.02	Diterpene
Consolidated total	98.42	

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

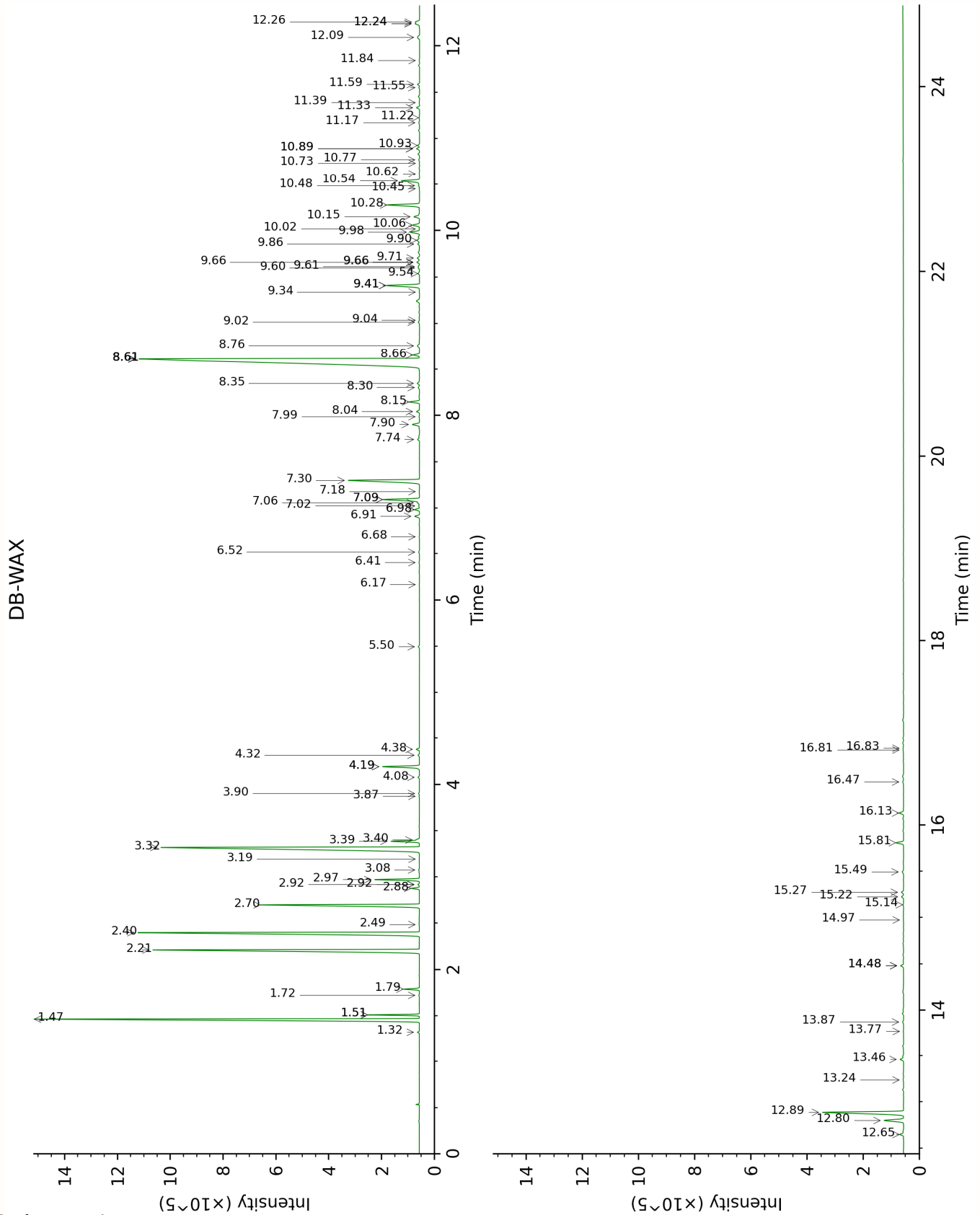
Note: no correction factor was applied

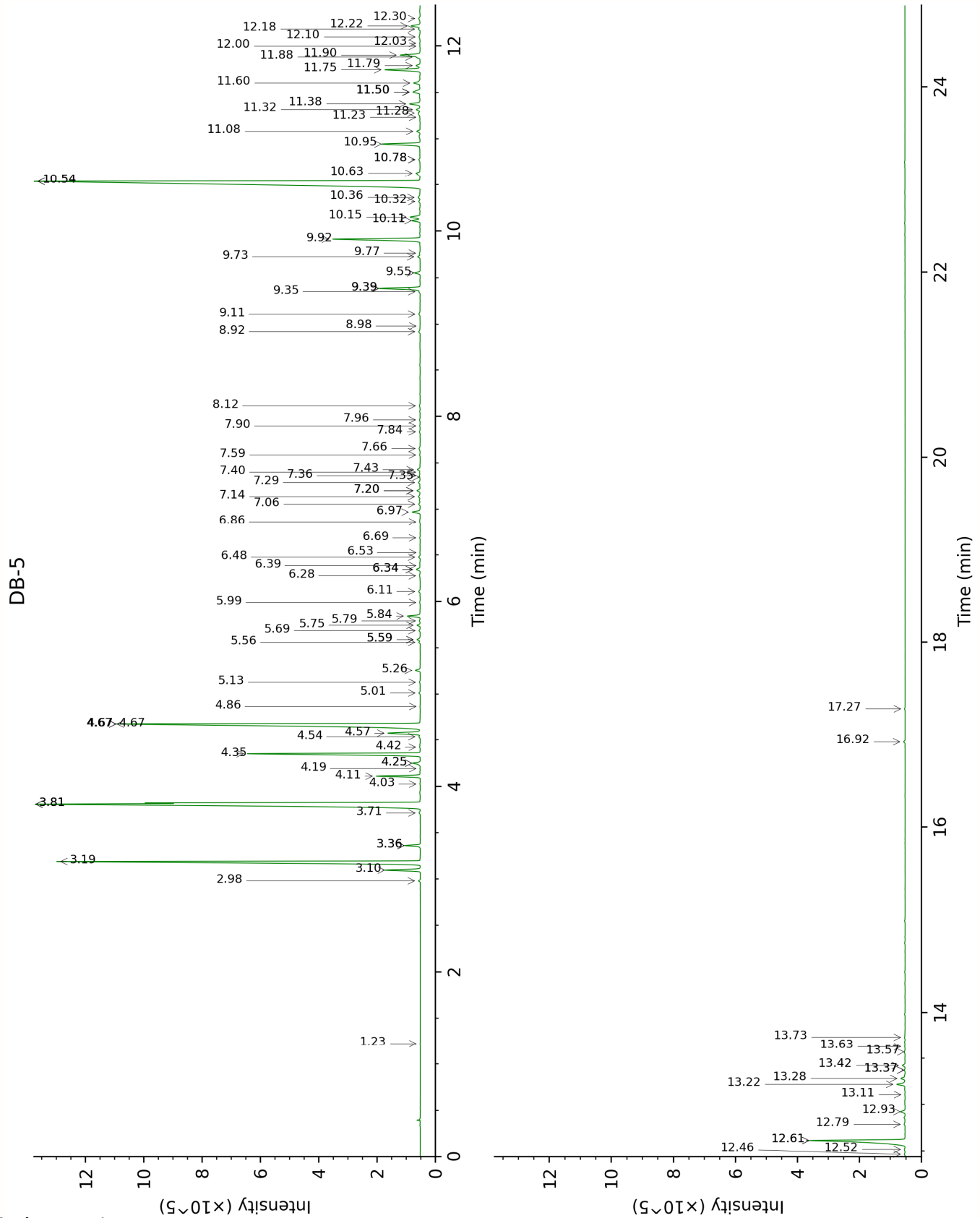
About "consolidated" data: The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm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

Toluene	Column DB-WAX			Column DB-5		
	1.51*	1005.6	[0.99]	1.22	759.7	0.01
Tricyclene	1.32	977.6	0.04	2.98	919.3	0.04
α -Thujene	1.51*	1005.6	[0.99]	3.10	927.0	0.99
α -Pinene	1.46	998.7	12.30	3.19	933.0	12.41
α -Fenchene	1.72	1026.8	0.02	3.36*	944.4	[0.40]
Camphene	1.79	1033.0	0.38	3.36*	944.4	[0.40]
3,7,7-Trimethylcyclohepta-1,3,5-triene	2.92*	1132.9	[0.04]	3.71	967.5	0.04
Sabinene	2.40	1090.2	10.71	3.81*	973.7	[20.87]
β -Pinene	2.21	1072.6	9.98	3.81*	973.7	[20.87]
Dehydro-1,8-cineole	3.19	1153.7	0.01	4.03	988.1	0.01
Myrcene	2.97	1136.9	1.19	4.11	993.7	1.15
2-Carene	2.49	1098.4	0.01	4.19	999.0	0.01
Pseudolimonene	2.92*	1132.9	[0.04]	4.25*	1002.9	[0.26]
α -Phellandrene	2.88	1129.7	0.21	4.25*	1002.9	[0.26]
Δ^3 -Carene	2.70	1116.3	5.32	4.35	1009.4	5.37
α -Terpinene	3.08	1144.8	0.02	4.42	1013.8	0.02
<i>meta</i> -Cymene	4.19*	1227.9	[1.14]	4.54	1020.9	0.04
<i>para</i> -Cymene	4.19*	1227.9	[1.14]	4.57	1023.3	1.11
β -Phellandrene	3.39	1168.2	0.77	4.67*	1029.4	[13.55]
1,8-Cineole	3.40	1169.3	0.06	4.67*	1029.4	[13.55]
Limonene	3.32	1163.2	12.63	4.67*	1029.4	[13.55]
(<i>Z</i>)- β -Ocimene	3.87	1205.1	0.01	4.86	1041.3	0.01
(<i>E</i>)- β -Ocimene	4.08	1219.8	0.04	5.02	1050.8	0.03
γ -Terpinene	3.90	1207.3	0.02	5.13	1058.0	0.02
<i>cis</i> -Sabinene hydrate	6.98	1429.3	0.16	5.26	1066.1	0.14
Isoterpinolene	4.32	1236.7	0.04	5.56	1085.0	0.04
<i>para</i> -Cymenene	6.40	1386.6	0.02	5.59*	1086.8	[0.11]
Terpinolene	4.38	1241.3	0.10	5.59*	1086.8	[0.11]
α -Pinene oxide	5.50	1321.0	0.04	5.69	1092.9	0.04
<i>trans</i> -Sabinene hydrate	8.04	1509.0	0.12	5.74	1096.5	0.09
Unknown PINI III [m/z 109, 43 (65), 95 (54), 119 (50), 91 (47)... 149 (8)...]	6.17	1369.4	0.01	5.79	1099.4	0.03
Linalool	8.15	1517.2	0.34	5.84	1102.7	0.40
Unknown BORI V [m/z 94, 59 (83), 43 (81), 95 (56), 109 (50), 79 (50), 91 (40)...]				5.99	1111.9	0.02
<i>trans-para</i> -Mentha-	9.02	1585.6	0.04	6.11	1119.5	0.05

2,8-dien-1-ol						
<i>cis</i> -Limonene oxide	6.52	1394.8	0.03	6.28	1130.3	0.04
<i>cis-para</i> -Mentha-2,8-dien-1-ol	9.54	1627.8	0.07	6.34*	1134.6	[0.14]
<i>trans</i> -Limonene oxide	6.68	1406.8	0.01	6.34*	1134.6	[0.14]
<i>trans-para</i> -Menth-2-en-1-ol	9.04	1587.3	0.01	6.39	1137.3	0.01
<i>trans</i> -Verbenol	9.61	1634.1	0.04	6.48	1143.2	0.05
<i>meta</i> -Mentha-4,6-dien-8-ol	9.41*	1617.2	[1.30]	6.53	1146.3	0.01
Pinocarvone	7.99	1504.8	0.02	6.69	1156.5	0.02
<i>cis</i> -Sabinol	10.89*	1741.8	[0.11]	6.86	1167.8	0.01
Terpinen-4-ol	8.66	1557.3	0.23	6.97	1174.6	0.27
<i>meta</i> -Cymen-8-ol	11.59	1792.7	0.07	7.06	1180.1	0.05
Unknown UNKN VI [m/z 43, 135 (73), 59 (46), 93 (39), 91 (35), 81 (32)...]				7.14	1185.2	0.07
α-Terpineol	9.90	1657.6	0.12	7.20*	1189.3	[0.11]
Myrtenal	8.76	1565.5	0.10	7.20*	1189.3	[0.11]
Myrtenol	10.93	1744.8	0.07	7.29	1195.0	0.07
<i>trans</i> -Isopiperitenol	10.45	1703.8	0.02	7.35	1198.7	0.01
<i>cis</i> -α-Phellandrene epoxide (iPr vs Me)	11.17	1756.5	0.04	7.36	1199.7	0.03
Unknown PINI IV [m/z 109, 91 (100), 81 (88), 94 (75), 119 (74), 96 (73), 41 (63)... 150 (2)]	10.89*	1741.8	[0.11]	7.40	1202.1	0.02
Verbenone	9.66*	1637.9	[0.10]	7.43	1203.9	0.10
Car-2-en-4-one?	9.60	1632.9	0.04	7.59	1214.3	0.02
<i>trans</i> -Carveol	11.55	1789.6	0.02	7.66	1219.0	0.05
<i>cis</i> -Carveol	11.84	1815.7	0.02	7.84	1231.0	0.03
Cuminal	10.62	1717.8	0.01	7.90	1235.2	0.02
Carvone	10.06	1671.2	0.27	7.96	1239.6	0.02
Unknown CALU IV [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	11.22	1761.1	0.03	8.12	1249.7	0.03
Car-3-en-5-one	12.24*†	1852.0	[0.16]	8.92	1303.6	0.07
<i>para</i> -Menth-5-en-1,2-diol isomer II	14.48*	2064.1	[0.11]	8.98	1307.7	0.01
<i>para</i> -Menth-5-en-1,2-diol isomer III	15.27	2143.2	0.08	9.11	1316.8	0.07

δ-Elemene isomer	7.02	1432.3	0.03	9.35	1333.8	0.03
δ-Elemene	7.09*	1437.5	[1.30]	9.39*	1336.3	[1.30]
Bicycloelemene	7.18	1443.9	0.02	9.39*	1336.3	[1.30]
α-Cubebene	6.91	1423.9	0.17	9.55	1348.0	0.18
Cyclosativene I	7.06	1434.9	0.06	9.73	1360.2	0.08
Cyclosativene II	7.09*	1437.5	[1.30]	9.76	1363.0	0.03
α-Copaene	7.30	1453.0	2.98	9.92	1373.6	3.00
β-Cubebene	7.90	1498.5	0.27	10.11	1387.6	0.27
β-Elemene	8.61*	1553.9	[24.70]	10.15	1390.3	0.36
Isocaryophyllene	8.30	1529.5	0.07	10.32	1402.1	0.05
α-Gurjunene	7.74	1486.3	0.07	10.36	1405.2	0.10
cis-α-Bergamotene	8.35	1533.0	0.10	10.54*	1418.1	[24.41]
β-Caryophyllene	8.61*	1553.9	[24.70]	10.54*	1418.1	[24.41]
β-Copaene	8.61*	1553.9	[24.70]	10.63	1424.8	0.13
α-Guaiene	8.61*	1553.9	[24.70]	10.78*	1435.9	[0.05]
trans-α-Bergamotene	8.61*	1553.9	[24.70]	10.78*	1435.9	[0.05]
α-Humulene	9.41*	1617.2	[1.30]	10.94	1448.4	1.24
(E)-β-Farnesene	9.66*	1637.9	[0.10]	11.08	1458.6	0.11
trans-Cadina-1(6),4-diene	9.34	1611.3	0.02	11.23	1469.9	0.01
γ-Muurolene	9.66*	1637.9	[0.10]	11.28	1473.2	0.06
Germacrene D	9.86	1654.2	0.07	11.32	1476.0	0.13
β-Selinene	9.98	1664.9	0.35	11.38	1480.6	0.38
α-Selinene	10.02	1667.7	0.01	11.50*	1490.0	[0.33]
Viridiflorene	9.71	1641.8	0.09	11.50*	1490.0	[0.33]
epi-Cubebol	12.09	1838.5	0.12	11.50*	1490.0	[0.33]
α-Muurolene	10.15	1678.7	0.24	11.60	1497.4	0.25
β-Bisabolene	10.28	1689.2	1.18	11.75	1508.1	1.17
Cubebol	12.65	1889.1	0.14	11.79	1511.7	0.15
trans-Calamenene	11.39	1775.4	0.02	11.88	1518.9	0.09
δ-Cadinene	10.54	1711.0	0.68	11.90	1520.5	0.69
trans-Cadina-1,4-diene	10.73	1727.9	0.01	12.00	1528.0	0.01
(E)-γ-Bisabolene	10.48	1706.6	0.05	12.03	1530.5	0.01
α-Calacorene	12.24*†	1852.0	[0.16]	12.10	1535.9	0.06
(E)-α-Bisabolene	10.77	1731.2	0.03	12.18	1542.5	0.05
Isocaryophyllene epoxide B	12.26*†	1853.6	[0.15]	12.22	1545.1	0.32
Germacrene B	11.33	1770.7	0.11	12.30	1551.4	0.07
(E)-Nerolidol	13.87	2004.4	0.04	12.46	1564.6	0.03
Spathulenol	14.48*	2064.1	[0.11]	12.52	1568.7	0.04
Caryophyllene oxide isomer	12.80	1902.9	0.78	12.61*	1576.2	[4.15]
Caryophyllene oxide	12.89	1911.0	3.23	12.61*	1576.2	[4.15]

Humulene epoxide I	13.24	1944.3	0.03	12.79	1589.9	0.04
Humulene epoxide II	13.46	1965.4	0.13	12.92	1600.7	0.16
α -Corocalene	13.77	1994.8	0.01	13.11	1615.5	0.02
Alismol	15.81	2197.8	0.26	13.22	1624.7	0.31
Caryophylladienol II	16.13	2231.2	0.16	13.28	1630.0	0.14
τ -Muurolol	15.14	2129.4	0.02	13.37*	1637.4	[0.02]
τ -Cadinol	14.98	2112.6	0.01	13.37*	1637.4	[0.02]
α -Muurolol	15.22	2138.2	0.08	13.42	1641.6	0.09
<i>cis</i> -Calamene-10-ol	16.47	2266.6	0.04	13.57	1653.7	0.03
<i>trans</i> -Calamene-10-ol	16.83	2305.1	0.02	13.63	1658.7	0.01
(3 <i>Z</i>)-Caryophylla-3,8(13)-dien-5 β -ol	16.81	2303.0	0.02	13.73	1667.1	0.02
<i>meta</i> -Camphorene	15.49	2165.7	0.06	16.92	1950.1	0.05
<i>para</i> -Camphorene				17.27	1983.8	0.02
Total reported		97.83%			98.87%	

*: 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