

Date : 2023-12-12

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 23L05-PTH03

Customer Identification : Organic Black Pepper - Sri Lanka - BS0108R

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

Date : 2023-12-11

PHYSICOCHEMICAL DATA

Refractive index : 1.479 ± 0.0003 (20 °C)

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

Analyst : Cindy Caron B. Sc.

Date : 2023-12-06

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	1.64	Monoterpene
α -Pinene	15.47	Monoterpene
Camphene	0.35	Monoterpene
α -Fenchene	0.02	Monoterpene
Thuja-2,4(10)-diene	tr	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.01	Monoterpene
Sabinene	15.44	Monoterpene
β -Pinene	10.48	Monoterpene
Dehydro-1,8-cineole	tr	Monoterpenic ether
Myrcene	1.71	Monoterpene
2-Carene	0.03	Monoterpene
α -Phellandrene	4.29	Monoterpene
Pseudolimonene	0.03	Monoterpene
Δ^3 -Carene	5.77	Monoterpene
α -Terpinene	0.11	Monoterpene
Carvomenthene	0.01	Aliphatic alcohol
<i>meta</i> -Cymene	0.01	Monoterpene
<i>para</i> -Cymene	0.96	Monoterpene
β -Phellandrene	1.59	Monoterpene
Limonene	12.34	Monoterpene
1,8-Cineole	0.32	Monoterpenic ether
(<i>Z</i>)- β -Ocimene	0.02	Monoterpene
(<i>E</i>)- β -Ocimene	0.13	Monoterpene
Unknown	0.01	Monoterpene
γ -Terpinene	0.12	Monoterpene
<i>cis</i> -Sabinene hydrate	0.06	Monoterpenic alcohol
Isoterpinolene	0.06	Monoterpene
Terpinolene	0.23	Monoterpene
<i>para</i> -Cymenene	0.01	Monoterpene
α -Pinene oxide	0.02	Monoterpenic ether
<i>trans</i> -Sabinene hydrate	0.04	Monoterpenic alcohol
Unknown	0.01	Unknown
Linalool	0.19	Monoterpenic alcohol
Unknown	0.01	Unknown
<i>trans-para</i> -Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
<i>cis</i> -Limonene oxide	0.02	Monoterpenic ether
<i>trans</i> -Limonene oxide	0.01	Monoterpenic ether

<i>cis-para</i> -Mentha-2,8-dien-1-ol	0.01	Monoterpenic alcohol
<i>trans-para</i> -Menth-2-en-1-ol	0.02	Monoterpenic alcohol
<i>trans</i> -Verbenol	0.03	Monoterpenic alcohol
1,4-Dimethyl-4-acetylcyclohexene	0.01	Monoterpenic ketone
<i>meta</i> -Mentha-4,6-dien-8-ol	0.06	Monoterpenic alcohol
Pinocarvone	0.01	Monoterpenic ketone
Borneol	0.01	Monoterpenic alcohol
<i>cis</i> -Sabinol	0.03	Monoterpenic alcohol
<i>trans</i> -2-Caren-4-ol	0.02	Monoterpenic alcohol
Terpinen-4-ol	0.20	Monoterpenic alcohol
Cryptone	0.06	Normonoterpenic ketone
<i>meta</i> -Cymen-8-ol	0.01	Monoterpenic alcohol
<i>para</i> -Cymen-8-ol	0.02	Monoterpenic alcohol
Myrtenal	0.04	Monoterpenic aldehyde
α -Terpineol	0.01	Monoterpenic alcohol
Myrtenol	0.02	Monoterpenic alcohol
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	0.06	Monoterpenic ether
Unknown	tr	Oxygenated monoterpene
Verbenone	0.03	Monoterpenic ketone
<i>trans</i> -Piperitol	0.01	Monoterpenic alcohol
Car-2-en-4-one?	0.01	Monoterpenic ketone
<i>trans</i> -Carveol	0.03	Monoterpenic alcohol
<i>cis</i> -Carveol	0.01	Monoterpenic alcohol
Cuminal	0.01	Monoterpenic aldehyde
Carvone	0.01	Monoterpenic ketone
Car-3-en-2-one	0.01	Monoterpenic ketone
Unknown	0.12	Unknown
Methyl citronellate	0.01	Monoterpenic ester
<i>trans</i> -Ascaridole glycol	0.01	Monoterpenic alcohol
Bornyl acetate	0.01	Monoterpenic ester
Unknown	0.01	Monoterpenic ester
Car-3-en-5-one	0.03	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	0.09	Monoterpenic alcohol
Unknown	0.01	Oxygenated monoterpene
δ -Elemene isomer	0.01	Sesquiterpene
Bicycloelemene	0.01	Sesquiterpene
δ -Elemene	0.52	Sesquiterpene
α -Cubebene	0.10	Sesquiterpene
Cyclosativene I	0.01	Sesquiterpene
Cyclosativene II	0.04	Sesquiterpene
α -Copaene	1.63	Sesquiterpene
β -Cubebene	0.18	Sesquiterpene
β -Elemene	0.13	Sesquiterpene
Isocaryophyllene	0.04	Sesquiterpene

α -Gurjunene	0.06	Sesquiterpene
β -Caryophyllene	19.96	Sesquiterpene
β -Copaene	0.11	Sesquiterpene
α -Guaiene	[0.04]	Sesquiterpene
<i>trans</i> - α -Bergamotene	[0.04]	Sesquiterpene
Unknown	0.01	Sesquiterpene
α -Humulene	0.69	Sesquiterpene
allo-Aromadendrene	0.04	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.07	Sesquiterpene
γ -Muurolene	0.04	Sesquiterpene
Germacrene D	0.12	Sesquiterpene
β -Selinene	0.08	Sesquiterpene
epi-Cubebol	0.04	Sesquiterpenic alcohol
Bicyclogermacrene	0.08	Sesquiterpene
Viridiflorene	0.02	Sesquiterpene
α -Selinene	0.05	Sesquiterpene
α -Muurolene	0.17	Sesquiterpene
γ -Cadinene	tr	Sesquiterpene
β -Bisabolene	0.71	Sesquiterpene
7-epi- α -Selinene	0.10	Sesquiterpene
δ -Cadinene	0.36	Sesquiterpene
<i>trans</i> -Calamenene	0.03	Sesquiterpene
(<i>E</i>)- γ -Bisabolene	0.01	Sesquiterpene
α -Cadinene	tr	Sesquiterpene
α -Calacorene	0.01	Sesquiterpene
(<i>E</i>)- α -Bisabolene	0.02	Sesquiterpene
Isocaryophyllene epoxide B	0.08	Sesquiterpenic ether
Germacrene B	0.02	Sesquiterpene
(<i>E</i>)-Nerolidol	0.02	Sesquiterpenic alcohol
Caryophyllene oxide	0.66	Sesquiterpenic ether
Caryophyllene oxide isomer	0.17	Sesquiterpenic ether
Humulene epoxide II	0.03	Sesquiterpenic ether
α -Corocalene	0.01	Sesquiterpene
Unknown	0.01	Oxygenated sesquiterpene
Alismol	0.11	Sesquiterpenic alcohol
Caryophylladienol I	0.01	Sesquiterpenic alcohol
Caryophylladienol II	0.04	Sesquiterpenic alcohol
τ -Muurolol	0.02	Sesquiterpenic alcohol
τ -Cadinol	0.01	Sesquiterpenic alcohol
α -Muurolol	0.06	Sesquiterpenic alcohol
<i>cis</i> -Calamenen-10-ol	0.01	Sesquiterpenic alcohol
(3 <i>Z</i>)-Caryophylla-3,8(13)-dien-5 β -ol	0.01	Sesquiterpenic alcohol
<i>meta</i> -Camphorene	0.03	Diterpene
<i>para</i> -Camphorene	0.02	Diterpene
Consolidated total	99.42	

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

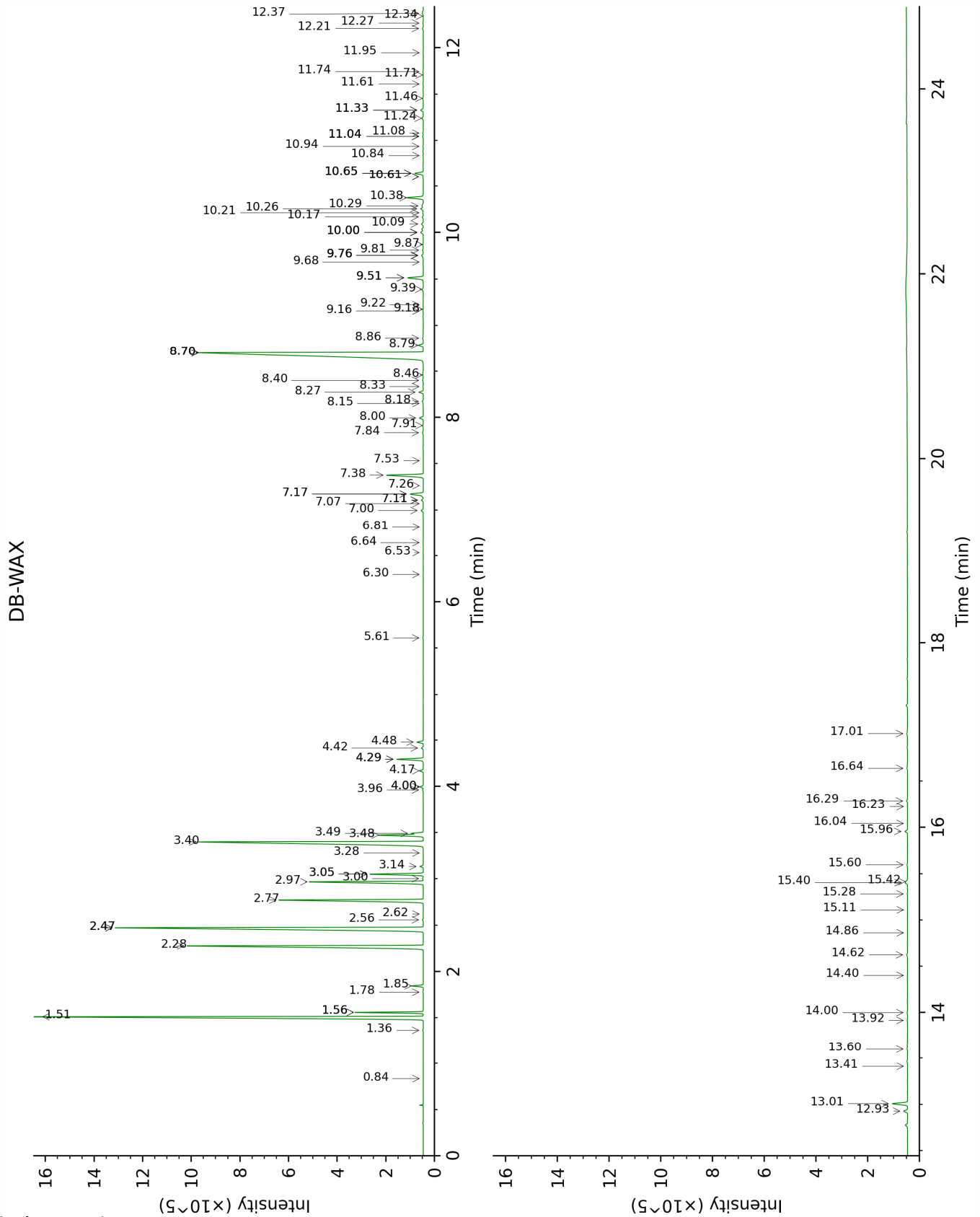
Note: no correction factor was applied

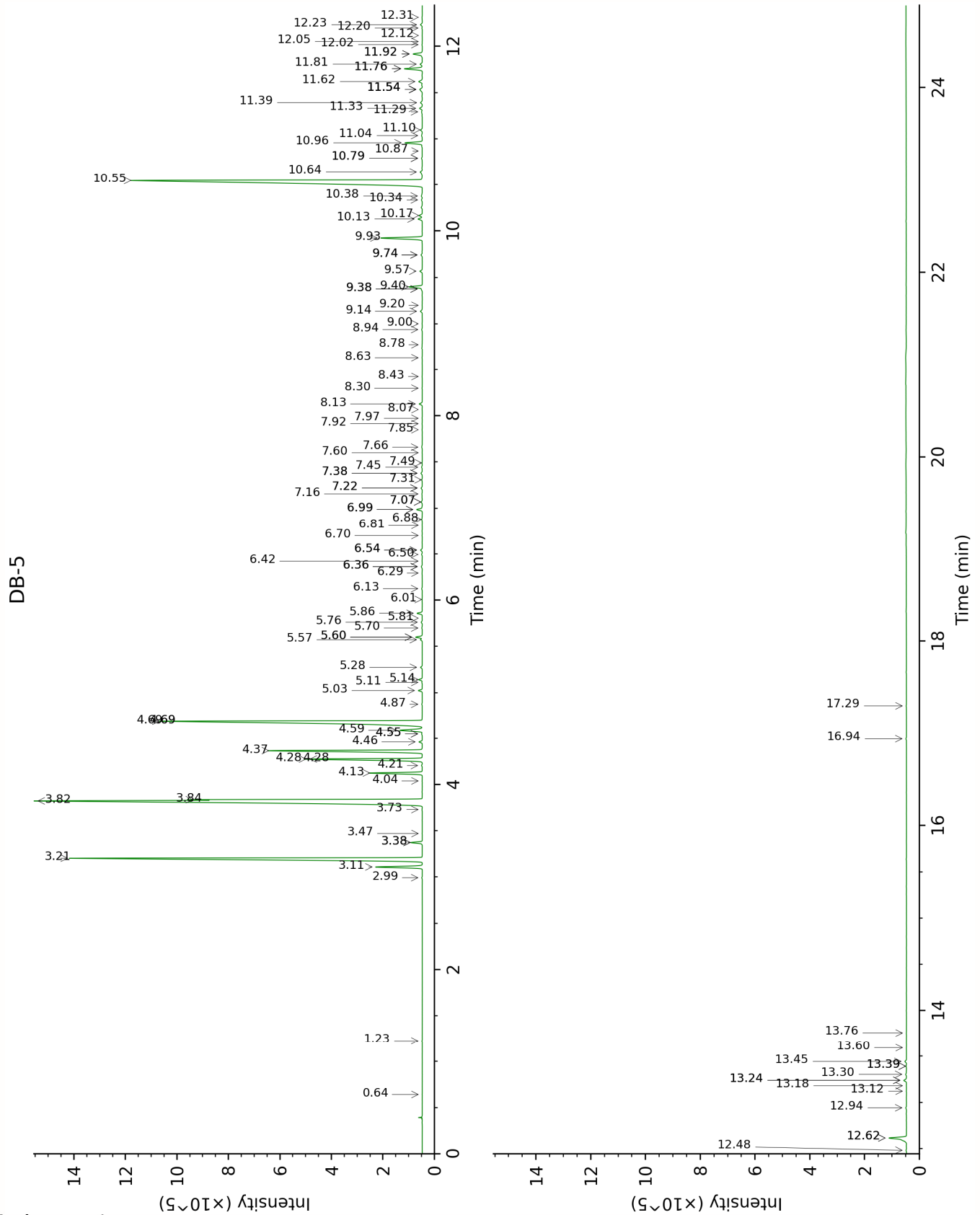
About "consolidated" data: The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm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

Isovaleral	Column DB-WAX			Column DB-5		
	0.84	886.6	tr	0.64	641.3	tr
Toluene	1.56*	1002.1	[1.65]	1.23	759.5	0.01
Tricyclene	1.36	974.0	0.02	2.99	919.2	0.02
α -Thujene	1.56*	1002.1	[1.65]	3.11	926.9	1.64
α -Pinene	1.51	996.3	15.42	3.20	933.1	15.47
Camphene	1.85	1029.0	0.35	3.38*	944.2	[0.37]
α -Fenchene	1.78	1022.6	0.02	3.38*	944.2	[0.37]
Thuja-2,4(10)-diene	2.47*	1088.2	[15.39]	3.47	950.6	tr
3,7,7-Trimethylcyclohepta-1,3,5-triene	3.05*	1134.3	[1.73]	3.73	967.6	0.01
Sabinene	2.47*	1088.2	[15.39]	3.82*†	973.8	[21.99]
β -Pinene	2.28	1069.8	10.48	3.84*†	974.7	[3.92]
Dehydro-1,8-cineole	3.28	1151.7	0.01	4.04	988.0	tr
Myrcene	3.05*	1134.3	[1.73]	4.13	993.6	1.71
2-Carene	2.56	1096.4	0.02	4.21	999.0	0.03
α -Phellandrene	2.97	1128.0	4.29	4.28*	1003.6	[4.31]
Pseudolimonene	3.00	1130.6	0.03	4.28*	1003.6	[4.31]
Δ 3-Carene	2.77	1113.1	5.75	4.37	1009.3	5.77
α -Terpinene	3.14	1140.6	0.11	4.46	1015.2	0.11
Carvomenthene	2.62	1101.6	0.01	4.55*	1020.7	[0.02]
<i>meta</i> -Cymene	4.29*	1226.6	[0.98]	4.55*	1020.7	[0.02]
<i>para</i> -Cymene	4.29*	1226.6	[0.98]	4.59	1023.1	0.96
β -Phellandrene	3.48	1166.3	1.59	4.69*	1029.2	[14.25]
Limonene	3.40	1160.7	12.34	4.69*	1029.2	[14.25]
1,8-Cineole	3.49	1167.7	0.32	4.69*	1029.2	[14.25]
(<i>Z</i>)- β -Ocimene	3.96	1203.0	0.03	4.87	1040.6	0.02
(<i>E</i>)- β -Ocimene	4.17	1217.7	0.14	5.02	1050.4	0.13
Unknown CUSE I [m/z 93, 91 (54), 92 (31), 77 (29), 79 (17), 43 (13), 41 (10), 136 (9)]	4.00*	1205.4	[0.12]	5.11	1055.9	0.01
γ -Terpinene	4.00*	1205.4	[0.12]	5.14	1057.7	0.12
<i>cis</i> -Sabinene hydrate	7.11*	1429.8	[0.08]	5.28	1066.1	0.06
Isoterpinolene	4.42	1235.2	0.07	5.57	1084.7	0.06
Terpinolene	4.48	1239.8	0.23	5.60*	1086.4	[0.24]
<i>para</i> -Cymenene	6.53	1387.8	0.01	5.60*	1086.4	[0.24]
α -Pinene oxide	5.61	1321.9	0.02	5.70	1092.6	0.02
<i>trans</i> -Sabinene hydrate	8.18	1509.2	0.04	5.76	1096.5	0.04
Unknown PINI III [m/z 109, 43 (65), 95	6.30	1370.9	0.01	5.81	1099.3	0.01

(54), 119 (50), 91 (47)... 149 (8)...						
Linalool	8.27	1516.8	0.17	5.86	1102.6	0.19
Unknown BORI V [m/z 94, 59 (83), 43 (81), 95 (56), 109 (50), 79 (50), 91 (40)...				6.01	1112.0	0.01
<i>trans-para</i> -Mentha-2,8-dien-1-ol	9.16	1584.8	0.01	6.13	1119.5	0.03
<i>cis</i> -Limonene oxide	6.64	1395.5	0.02	6.29	1130.2	0.02
<i>trans</i> -Limonene oxide	6.81	1407.9	0.01	6.36*	1134.7	[0.05]
<i>cis-para</i> -Mentha-2,8-dien-1-ol	9.68	1626.7	0.01	6.36*	1134.7	[0.05]
<i>trans-para</i> -Menth-2-en-1-ol	9.18	1586.2	0.01	6.42	1138.5	0.02
<i>trans</i> -Verbenol	9.76*	1632.5	[0.10]	6.50	1143.0	0.03
1,4-Dimethyl-4-acetylcyclohexene	7.53	1461.3	0.01	6.54*	1146.1	[0.07]
<i>meta</i> -Mentha-4,6-dien-8-ol	9.51*	1613.1	[0.70]	6.54*	1146.1	[0.07]
Pinocarvone	8.15	1507.4	0.02	6.70	1156.2	0.01
Borneol	10.00*†	1652.5	[0.14]	6.81	1163.2	0.01
<i>cis</i> -Sabinol	11.04*	1738.5	[0.03]	6.88	1167.6	0.03
<i>trans</i> -2-Caren-4-ol	7.91	1489.4	0.02	6.99*	1174.5	[0.21]
Terpinen-4-ol	8.79	1556.4	0.20	6.99*	1174.5	[0.21]
Cryptone	9.39	1603.1	0.06	7.07*	1179.7	[0.04]
<i>meta</i> -Cymen-8-ol	11.71	1794.4	0.01	7.07*	1179.7	[0.04]
<i>para</i> -Cymen-8-ol	11.74	1797.5	0.02	7.16	1185.2	0.02
Myrtenal	8.86	1562.3	0.04	7.22*	1189.3	[0.04]
α -Terpineol	10.00*†	1652.5	[0.14]	7.22*	1189.3	[0.04]
Myrtenol	11.08	1741.4	0.02	7.31	1194.9	0.02
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	11.24	1755.1	0.06	7.38*	1199.5	[0.06]
Unknown PINI IV [m/z 109, 91 (100), 81 (88), 94 (75), 119 (74), 96 (73), 41 (63)... 150 (2)]	11.04*	1738.5	[0.03]	7.38*	1199.5	[0.06]
Verbenone	9.81	1637.0	0.04	7.45	1203.7	0.03
<i>trans</i> -Piperitol	10.60*	1701.3	[0.02]	7.49	1206.7	0.01
Car-2-en-4-one?	9.76*	1632.5	[0.10]	7.60	1214.1	0.01
<i>trans</i> -Carveol	11.61	1786.2	0.01	7.66	1218.1	0.03
<i>cis</i> -Carveol	11.95	1815.5	0.01	7.85	1230.7	0.01
Cuminal	10.84	1720.9	0.01	7.92	1235.0	0.01

Carvone	10.21	1669.5	0.02	7.97	1238.9	0.01
Car-3-en-2-one	10.60*	1701.3	[0.02]	8.07	1245.2	0.01
Unknown CALU IV [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	11.33*	1762.4	[0.13]	8.13	1249.3	0.12
Methyl citronellate	8.40	1526.6	0.04	8.30	1260.7	0.01
<i>trans</i> -Ascaridole glycol	14.40	2039.7	0.01	8.43	1269.1	0.01
Bornyl acetate	8.46	1531.1	0.02	8.63	1282.6	0.01
Unknown SCMO II [m/z 93, 43 (60), 108 (58), 69 (36), 41 (35)... 150 (5), 184 (1)]	13.41	1946.8	0.01	8.78	1292.5	0.01
Car-3-en-5-one	12.34	1850.3	0.01	8.94	1303.4	0.03
<i>para</i> -Menth-5-en- 1,2-diol isomer II	14.62	2060.9	0.05	9.00	1307.8	0.01
<i>para</i> -Menth-5-en- 1,2-diol isomer III	15.40	2137.4	0.10	9.14	1317.2	0.09
Unknown MISC XI [m/z 91, 79 (94), 77 (72), 41 (37), 93 (31)... 152 (1)]				9.20	1321.7	0.01
δ -Elemene isomer	7.07	1427.0	0.01	9.38*	1334.1	[0.03]
Bicycloelemene	7.26	1441.5	0.01	9.38*	1334.1	[0.03]
δ -Elemene	7.17*	1434.7	[0.61]	9.40	1335.8	0.52
α -Cubebene	7.00	1421.6	0.10	9.57	1347.6	0.10
Cyclosativene I	7.11*	1429.8	[0.08]	9.74*	1360.0	[0.05]
Cyclosativene II	7.17*	1434.7	[0.61]	9.74*	1360.0	[0.05]
α -Copaene	7.38	1449.8	1.63	9.93	1372.8	1.63
β -Cubebene	8.00	1495.5	0.17	10.13	1387.2	0.18
β -Elemene	8.70*	1549.7	[20.09]	10.17	1389.9	0.13
Isocaryophyllene	8.33	1521.4	0.02	10.34	1401.7	0.04
α -Gurjunene	7.84	1483.6	0.04	10.38	1404.7	0.06
β -Caryophyllene	8.70*	1549.7	[20.09]	10.55	1417.2	19.96
β -Copaene	8.70*	1549.7	[20.09]	10.64	1424.4	0.11
α -Guaiene	8.70*	1549.7	[20.09]	10.79*	1435.4	[0.04]
<i>trans</i> - α - Bergamotene	8.70*	1549.7	[20.09]	10.79*	1435.4	[0.04]
Unknown ZIOF XV [m/z 139, 69 (60), 41 (51), 43 (47), 119 (41)... 204 (1)]				10.87	1441.3	0.01
α -Humulene	9.51*	1613.1	[0.70]	10.96	1447.9	0.69
allo-Aromadendrene	9.22	1590.1	0.02	11.04	1453.7	0.04

(E)-β-Farnesene	9.76*	1632.5	[0.10]	11.10	1458.2	0.07
γ-Muuroolene	9.76*	1632.5	[0.10]	11.29	1472.8	0.04
Germacrene D	10.00*†	1652.5	[0.14]	11.33	1475.6	0.12
β-Selinene	10.09	1659.8	0.08	11.39	1480.1	0.08
epi-Cubebol	12.21	1838.6	0.04	11.54*	1490.8	[0.15]
Bicyclogermacrene	10.29	1675.5	0.08	11.54*	1490.8	[0.15]
Viridiflorene	9.87	1642.0	0.02	11.54*	1490.8	[0.15]
α-Selinene	10.17	1666.0	0.05	11.54*	1490.8	[0.15]
α-Muuroolene	10.26	1673.0	0.12	11.62	1497.1	0.17
γ-Cadinene	10.60*	1701.3	[0.02]	11.76*	1507.6	[0.70]
β-Bisabolene	10.38	1682.6	0.71	11.76*	1507.6	[0.70]
7-epi-α-Selinene	10.65*	1704.8	[0.37]	11.81	1511.5	0.10
δ-Cadinene	10.65*	1704.8	[0.37]	11.92*	1520.1	[0.40]
<i>trans</i> -Calamenene	11.46	1773.1	0.03	11.92*	1520.1	[0.40]
(E)-γ-Bisabolene	10.65*	1704.8	[0.37]	12.02	1528.0	0.01
α-Cadinene	11.04*	1738.5	[0.03]	12.05	1530.6	tr
α-Calacorene	12.27	1843.7	0.02	12.12	1535.8	0.01
(E)-α-Bisabolene	10.94	1729.3	0.02	12.20	1542.0	0.02
Isocaryophyllene epoxide B	12.37	1853.0	0.04	12.24	1544.8	0.08
Germacrene B	11.33*	1762.4	[0.13]	12.32	1551.1	0.02
(E)-Nerolidol	14.00	2001.1	0.03	12.48	1564.2	0.02
Caryophyllene oxide	13.01	1909.6	0.66	12.62*	1574.7	[0.87]
Caryophyllene oxide isomer	12.93	1902.1	0.17	12.62*	1574.7	[0.87]
Humulene epoxide II	13.60	1964.0	0.02	12.94	1600.3	0.03
α-Corocalene	13.92	1993.1	0.03	13.12	1614.9	0.01
Unknown MECA IV [m/z 161, 43 (74), 105 (57), 121 (45), 81 (43)... 204 (31)...]	14.86	2083.7	0.01	13.18	1619.8	0.01
Alismol	15.96	2192.7	0.11	13.24*	1624.6	[0.12]
Caryophylladienol I	16.23	2220.6	0.01	13.24*	1624.6	[0.12]
Caryophylladienol II	16.29	2226.7	0.04	13.30	1630.0	0.04
τ-Muurolol	15.28	2125.2	0.02	13.39*	1637.3	[0.02]
τ-Cadinol	15.11	2108.0	0.01	13.39*	1637.3	[0.02]
α-Muurolol	15.42	2138.6	0.06	13.44	1641.5	0.06
<i>cis</i> -Calamenen-10-ol	16.64	2263.3	0.04	13.60	1653.9	0.01
(3Z)-Caryophylla- 3,8(13)-dien-5β-ol	17.01	2302.6	0.05	13.76	1667.4	0.01
<i>meta</i> -Camphorene	15.60	2156.6	0.04	16.94	1949.8	0.03
<i>para</i> -Camphorene	16.04	2201.6	0.01	17.29	1983.5	0.02
Total reported		99.01%			99.39%	

*: 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