

Date : 2025-06-02

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 25E16-PTH02

Customer Identification : Black Pepper - India - B40112R

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 : Anne Retailaud

Date : 2025-05-30

PHYSICOCHEMICAL DATA

Refractive index : 1.4828 ± 0.0003 (20 °C)

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

Analyst : Cindy Caron B. Sc.

Date : 2025-05-16

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
Toluene	tr	Simple phenolic
Tricyclene	0.02	Monoterpene
α -Thujene	0.75	Monoterpene
α -Pinene	10.16	Monoterpene
α -Fenchene	0.01	Monoterpene
Camphene	0.22	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.01	Monoterpene
Sabinene	9.14	Monoterpene
β -Pinene	13.42	Monoterpene
Dehydro-1,8-cineole	0.01	Monoterpenic ether
Myrcene	1.22	Monoterpene
2-Carene	0.03	Monoterpene
α -Phellandrene	1.59	Monoterpene
Pseudolimonene	0.03	Monoterpene
Δ^3 -Carene	6.59	Monoterpene
α -Terpinene	0.10	Monoterpene
Carvomenthene	0.02	Aliphatic alcohol
<i>meta</i> -Cymene	0.03	Monoterpene
<i>para</i> -Cymene	1.21	Monoterpene
β -Phellandrene	[1.24]	Monoterpene
Limonene	13.65	Monoterpene
1,8-Cineole	[1.24]	Monoterpenic ether
(Z)- β -Ocimene	0.02	Monoterpene
(E)- β -Ocimene	0.13	Monoterpene
γ -Terpinene	0.12	Monoterpene
<i>cis</i> -Sabinene hydrate	0.09	Monoterpenic alcohol
Isoterpinolene	0.05	Monoterpene
Terpinolene	0.23	Monoterpene
α -Pinene oxide	0.03	Monoterpenic ether
<i>trans</i> -Sabinene hydrate	0.06	Monoterpenic alcohol
Linalool	0.27	Monoterpenic alcohol
<i>trans-para</i> -Mentha-2,8-dien-1-ol	0.02	Monoterpenic alcohol
<i>cis-para</i> -Menth-2-en-1-ol	0.02	Monoterpenic alcohol
<i>cis</i> -Limonene oxide	0.02	Monoterpenic ether
<i>cis-para</i> -Mentha-2,8-dien-1-ol	0.06	Monoterpenic alcohol
<i>trans</i> -Limonene oxide	0.01	Monoterpenic ether
<i>trans-para</i> -Menth-2-en-1-ol	0.02	Monoterpenic alcohol
<i>trans</i> -Verbenol	0.02	Monoterpenic alcohol
<i>meta</i> -Mentha-4,6-dien-8-ol	0.01	Monoterpenic alcohol

Sabinaketone	0.01	Normoterpenic ketone
Pinocarvone	0.02	Monoterpenic ketone
<i>cis</i> -Sabinol	0.01	Monoterpenic alcohol
Terpinen-4-ol	0.24	Monoterpenic alcohol
<i>trans</i> -2-Caren-4-ol	0.02	Monoterpenic alcohol
<i>meta</i> -Cymen-8-ol	0.03	Monoterpenic alcohol
Cryptone	0.03	Normoterpenic ketone
<i>para</i> -Cymen-8-ol	0.01	Monoterpenic alcohol
α -Terpineol	0.07	Monoterpenic alcohol
Myrtenal	0.01	Monoterpenic aldehyde
Myrtenol	0.04	Monoterpenic alcohol
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	0.02	Monoterpenic ether
Verbenone	0.04	Monoterpenic ketone
Car-2-en-4-one?	0.01	Monoterpenic ketone
<i>trans</i> -Carveol	0.02	Monoterpenic alcohol
<i>cis</i> -Carveol	0.02	Monoterpenic alcohol
Cuminal	0.02	Monoterpenic aldehyde
Carvone	0.01	Monoterpenic ketone
Car-3-en-2-one	0.01	Monoterpenic ketone
Unknown	0.02	Unknown
<i>trans</i> -Ascaridole glycol	0.01	Monoterpenic alcohol
Cuminol	0.01	Monoterpenic alcohol
Unknown	0.01	Oxygenated monoterpene
Car-3-en-5-one	0.01	Monoterpenic ketone
<i>para</i> -Menth-5-en-1,2-diol isomer II	0.03	Monoterpenic alcohol
<i>para</i> -Menth-5-en-1,2-diol isomer III	0.04	Monoterpenic alcohol
Methyl geranate	0.01	Monoterpenic ester
δ -Elemene isomer	0.02	Sesquiterpene
Bicycloelemene	0.02	Sesquiterpene
δ -Elemene	1.39	Sesquiterpene
α -Cubebene	0.26	Sesquiterpene
Eugenol	0.02	Phenylpropanoid
Cyclosativene I	0.09	Sesquiterpene
Cyclosativene II	0.02	Sesquiterpene
α -Ylangene	0.01	Sesquiterpene
α -Copaene	3.49	Sesquiterpene
<i>cis</i> - β -Elemene	0.02	Sesquiterpene
β -Cubebene	0.34	Sesquiterpene
β -Elemene	0.29	Sesquiterpene
Isocaryophyllene	0.03	Sesquiterpene
α -Gurjunene	0.09	Sesquiterpene
<i>cis</i> - α -Bergamotene	0.03	Sesquiterpene
β -Caryophyllene	23.60	Sesquiterpene
β -Copaene	0.16	Sesquiterpene
α -Guaiene	[0.04]	Sesquiterpene

<i>trans</i> - α -Bergamotene	[0.04]	Sesquiterpene
<i>trans</i> -Muurolo-3,5-diene	0.03	Sesquiterpene
α -Humulene	0.89	Sesquiterpene
allo-Aromadendrene	0.02	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.16	Sesquiterpene
β -Santalene	0.01	Sesquiterpene
γ -Gurjunene	0.02	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.03	Sesquiterpene
γ -Muurolole	[0.10]	Sesquiterpene
α -Amorphene	[0.10]	Sesquiterpene
Germacrene D	0.27	Sesquiterpene
α -Curcumene	0.06	Sesquiterpene
β -Selinene	0.24	Sesquiterpene
α -Selinene	0.16	Sesquiterpene
epi-Cubebol	0.10	Sesquiterpenic alcohol
Bicyclogermacrene	0.04	Sesquiterpene
Viridiflorene	0.03	Sesquiterpene
α -Muurolole	0.40	Sesquiterpene
Cubebol	0.16	Sesquiterpenic alcohol
γ -Cadinene	0.06	Sesquiterpene
β -Bisabolene	2.09	Sesquiterpene
7-epi- α -Selinene	0.14	Sesquiterpene
<i>trans</i> -Calamenene	0.10	Sesquiterpene
δ -Cadinene	1.01	Sesquiterpene
(<i>E</i>)- γ -Bisabolene	0.04	Sesquiterpene
α -Calacorene	0.02	Sesquiterpene
(<i>E</i>)- α -Bisabolene	0.05	Sesquiterpene
Isocaryophyllene epoxide B	0.04	Sesquiterpenic ether
α -Elemol	0.02	Sesquiterpenic alcohol
Germacrene B	0.04	Sesquiterpene
(<i>E</i>)-Nerolidol	0.04	Sesquiterpenic alcohol
Spathulenol	0.10	Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.20	Sesquiterpenic ether
Caryophyllene oxide	0.80	Sesquiterpenic ether
Unknown	0.01	Oxygenated sesquiterpene
Humulene epoxide I	0.01	Sesquiterpenic ether
Ledol	0.03	Sesquiterpenic alcohol
Humulene epoxide II	0.05	Sesquiterpenic ether
α -Corocalene	0.02	Sesquiterpene
Unknown	0.02	Oxygenated sesquiterpene
Alismol	0.20	Sesquiterpenic alcohol
Caryophylladienol II	0.04	Sesquiterpenic alcohol
Isospathulenol	0.02	Sesquiterpenic alcohol
τ -Cadinol	0.01	Sesquiterpenic alcohol
τ -Muurolol	0.03	Sesquiterpenic alcohol

α -Muurolol	0.13	Sesquiterpenic alcohol
cis-Calamenen-10-ol	0.01	Sesquiterpenic alcohol
trans-Calamenen-10-ol	0.02	Sesquiterpenic alcohol
(3Z)-Caryophylla-3,8(13)-dien-5 β -ol	0.01	Sesquiterpenic alcohol
Phytone	0.01	Terpenic ketone
meta-Camphorene	0.01	Diterpene
Consolidated total	99.44	

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

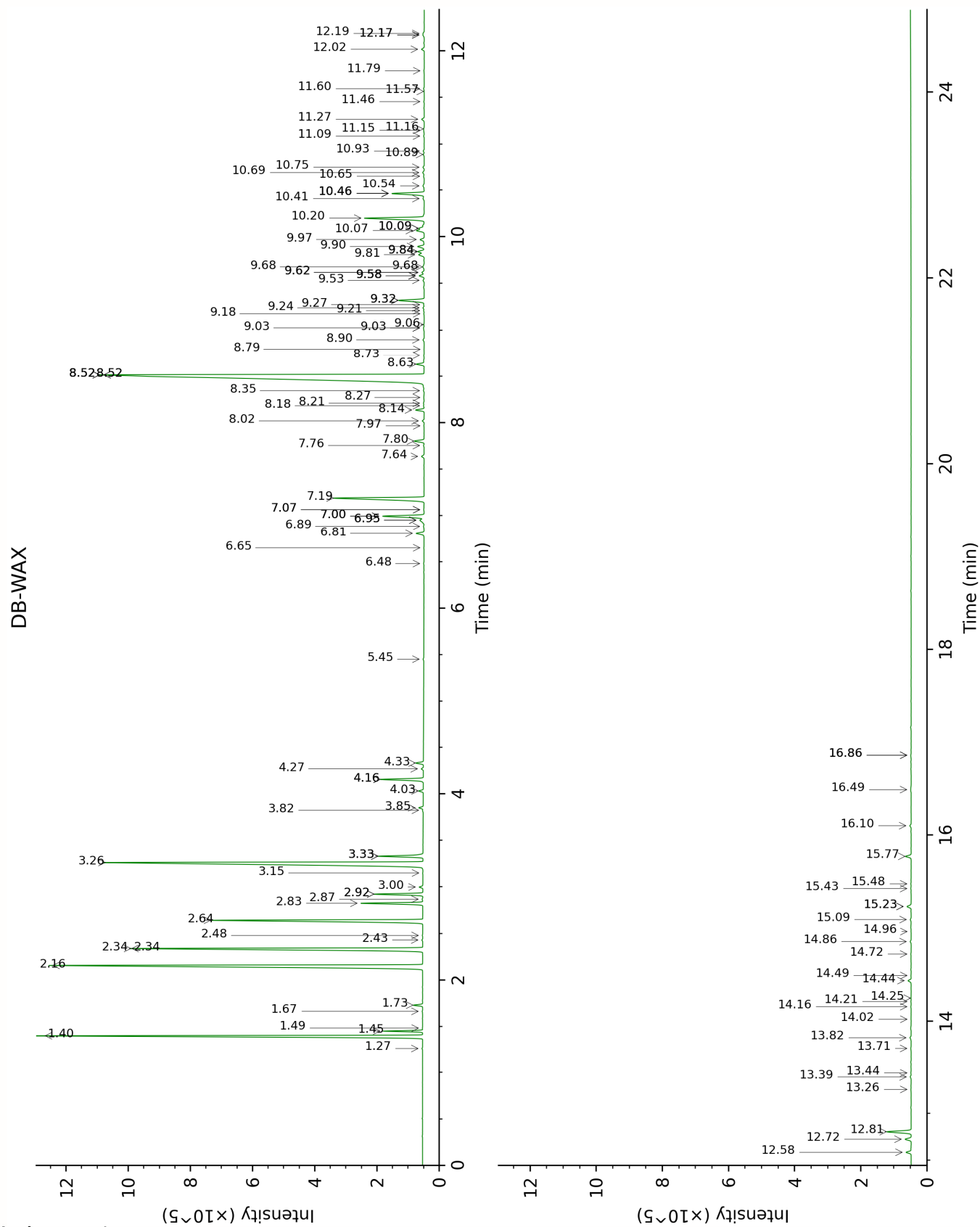
Note: no correction factor was applied

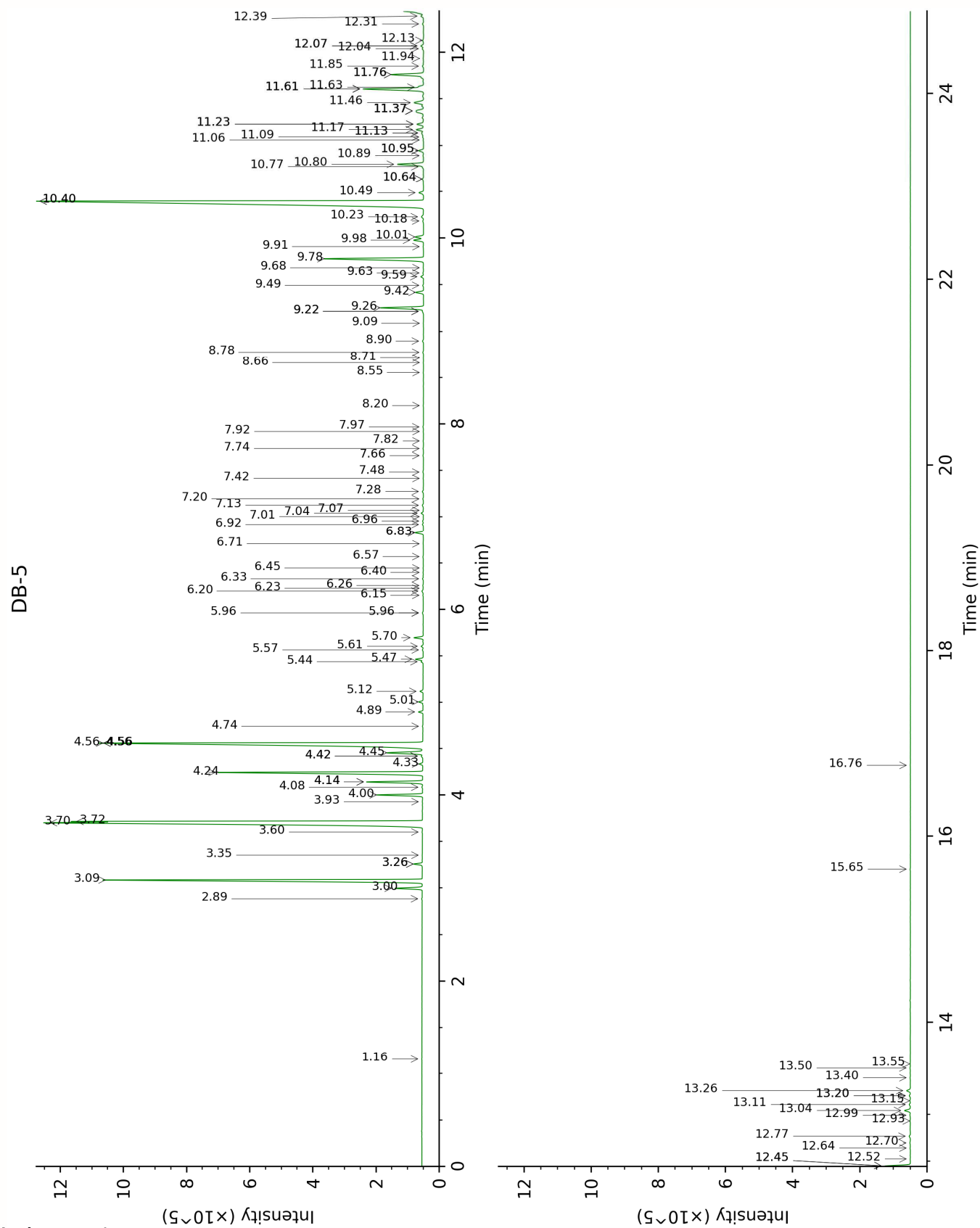
About "consolidated" data: The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm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

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FULL ANALYSIS DATA

Toluene	Column DB-WAX			Column DB-5		
	1.48	1001.0	0.01	1.16	757.9	tr
Tricyclene	1.27	970.0	0.02	2.89	918.4	0.02
α -Thujene	1.45	997.8	0.74	3.00	926.0	0.75
α -Pinene	1.40	992.3	10.15	3.09	931.9	10.16
α -Fenchene	1.66	1018.8	0.01	3.26*	943.4	[0.24]
Camphene	1.73	1025.4	0.22	3.26*	943.4	[0.24]
Thuja-2,4(10)-diene	2.34*	1085.8	[9.14]	3.35	949.7	0.01
3,7,7-Trimethylcyclohepta-1,3,5-triene	2.92*	1133.4	[1.23]	3.60	966.4	0.01
Sabinene	2.34*	1085.8	[9.14]	3.70*†	973.1	[16.67]
β -Pinene	2.16	1067.7	13.42	3.72*†	974.0	[5.88]
Dehydro-1,8-cineole	3.15	1151.2	0.01	3.93	988.2	0.01
Myrcene	2.92*	1133.4	[1.23]	4.00	993.1	1.22
2-Carene	2.43	1094.6	0.03	4.08	998.7	0.03
α -Phellandrene	2.83	1125.6	1.59	4.14*	1002.5	[1.60]
Pseudolimonene	2.87	1129.0	0.03	4.14*	1002.5	[1.60]
Δ 3-Carene	2.64	1111.3	6.58	4.24	1009.0	6.59
α -Terpinene	3.00	1139.3	0.10	4.33	1014.8	0.10
Carvomenthene	2.48	1098.5	0.02	4.42*	1020.1	[0.05]
<i>meta</i> -Cymene	4.16*	1227.8	[1.23]	4.42*	1020.1	[0.05]
<i>para</i> -Cymene	4.16*	1227.8	[1.23]	4.45	1022.4	1.21
β -Phellandrene	3.33*	1165.4	[1.25]	4.56*	1029.0	[14.89]
Limonene	3.26	1160.0	13.65	4.56*	1029.0	[14.89]
1,8-Cineole	3.33*	1165.4	[1.25]	4.56*	1029.0	[14.89]
(Z)- β -Ocimene	3.82	1203.5	0.02	4.74	1040.4	0.02
(E)- β -Ocimene	4.03	1218.7	0.12	4.89	1050.3	0.13
γ -Terpinene	3.85	1205.6	0.13	5.01	1057.6	0.12
<i>cis</i> -Sabinene hydrate	6.95*	1429.9	[0.21]	5.12	1064.8	0.09
Isoterpinolene	4.27	1236.1	0.06	5.44	1085.0	0.05
Terpinolene	4.33	1240.7	0.22	5.47	1086.7	0.23
α -Pinene oxide	5.45	1322.4	0.02	5.57	1093.0	0.03
<i>trans</i> -Sabinene hydrate	8.02	1508.8	0.06	5.61	1095.5	0.06
Linalool	8.14	1517.7	0.25	5.70	1101.4	0.27
<i>trans-para</i> -Mentha-2,8-dien-1-ol	9.02*	1585.8	[0.04]	5.96*	1118.6	[0.04]
<i>cis-para</i> -Mentha-2-en-1-ol	8.18	1521.2	0.02	5.96*	1118.6	[0.04]
<i>cis</i> -Limonene oxide	6.48	1395.2	0.01	6.15	1130.8	0.02
<i>cis-para</i> -Mentha-2,8-dien-1-ol	9.53	1626.3	0.04	6.20	1133.8	0.06
<i>trans</i> -Limonene	6.65	1407.7	0.01	6.23	1135.7	0.01

oxide						
<i>trans-para</i> -Menth-2-en-1-ol	9.02*	1585.8	[0.04]	6.26	1137.7	0.02
<i>trans</i> -Verbenol	9.58*	1630.2	[0.18]	6.33	1142.4	0.02
<i>meta</i> -Mentha-4,6-dien-8-ol	9.32*	1609.2	[0.90]	6.40	1146.8	0.01
Sabinaketone	8.80	1568.1	0.01	6.45	1149.9	0.01
Pinocarvone	7.97	1504.7	0.01	6.57	1157.8	0.02
<i>cis</i> -Sabinol	10.89	1737.2	0.04	6.71	1166.8	0.01
Terpinen-4-ol	8.63	1555.5	0.24	6.83*	1174.6	[0.26]
<i>trans</i> -2-Caren-4-ol	7.76	1488.7	0.02	6.83*	1174.6	[0.26]
<i>meta</i> -Cymen-8-ol	11.60	1797.0	0.03	6.92	1180.7	0.03
Cryptone	9.24	1602.8	0.04	6.96	1183.1	0.03
<i>para</i> -Cymen-8-ol	11.57	1794.4	0.01	7.01	1186.2	0.01
α -Terpineol	9.84*	1651.0	[0.23]	7.04	1188.7	0.07
Myrtenal	8.73	1563.0	0.02	7.07	1190.6	0.01
Myrtenol	10.93	1740.3	0.03	7.13	1194.1	0.04
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	11.09	1753.8	0.02	7.20	1198.6	0.02
Verbenone	9.68*	1637.8	[0.07]	7.28	1203.8	0.04
Car-2-en-4-one?	9.58*	1630.2	[0.18]	7.42	1213.3	0.01
<i>trans</i> -Carveol	11.46	1785.0	0.02	7.48	1217.9	0.02
<i>cis</i> -Carveol	11.79	1813.8	0.02	7.66	1230.0	0.02
Cuminal	10.66	1717.5	0.03	7.74	1235.2	0.02
Carvone	10.07*†	1669.1	[0.28]	7.82	1240.7	0.01
Car-3-en-2-one	10.46*	1701.4	[1.08]	7.92	1247.7	0.01
Unknown CALU IV [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	11.16	1760.3	0.02	7.97	1251.0	0.02
<i>trans</i> -Ascaridole glycol	14.21	2035.4	0.01	8.20	1266.7	0.01
Cuminol	14.25	2038.9	0.01	8.55	1290.9	0.01
Unknown MISC IX [m/z 43, 93 (66), 91 (44), 41 (38), 69 (35)... 152? (1)]				8.66	1298.3	0.01
Car-3-en-5-one	12.17*	1847.6	[0.05]	8.71	1301.9	0.01
<i>para</i> -Menth-5-en-1,2-diol isomer II	14.49	2062.2	0.01	8.78	1306.2	0.03
<i>para</i> -Menth-5-en-1,2-diol isomer III	15.23*	2135.3	[0.15]	8.90	1311.0	0.04
Methyl geranate	9.84*	1651.0	[0.23]	9.09	1324.6	0.01
δ -Elemene isomer	6.89	1425.0	0.02	9.22*	1333.7	[0.05]
Bicycloelemene	7.07*	1438.2	[0.02]	9.22*	1333.7	[0.05]

δ -Elemene	7.00*	1433.1	[1.40]	9.26	1336.4	1.39
α -Cubebene	6.81	1419.0	0.25	9.42	1348.2	0.26
Eugenol	14.86	2097.7	0.04	9.50	1353.5	0.02
Cyclosativene I	6.95*	1429.9	[0.21]	9.59	1360.1	0.09
Cyclosativene II	7.00*	1433.1	[1.40]	9.63	1363.0	0.02
α -Ylangene	7.07*	1438.2	[0.02]	9.68	1366.9	0.01
α -Copaene	7.19	1447.3	3.47	9.78	1373.8	3.49
<i>cis</i> - β -Elemene	8.34	1533.6	0.03	9.91	1383.0	0.02
β -Cubebene	7.80	1492.2	0.32	9.98	1388.0	0.34
β -Elemene	8.52*	1546.7	[24.00]	10.01	1390.4	0.29
Isocaryophyllene	8.21	1523.4	0.03	10.18	1402.6	0.03
α -Gurjunene	7.64	1480.1	0.09	10.23	1405.8	0.09
<i>cis</i> - α -Bergamotene	8.27	1528.0	0.03	10.40*	1418.4	[23.63]
β -Caryophyllene	8.52*	1546.7	[24.00]	10.40*	1418.4	[23.63]
β -Copaene	8.52*	1546.7	[24.00]	10.49	1425.2	0.16
α -Guaiene	8.52*	1546.7	[24.00]	10.64*	1436.7	[0.04]
<i>trans</i> - α -Bergamotene	8.52*	1546.7	[24.00]	10.64*	1436.7	[0.04]
<i>trans</i> -Muurolo-3,5-diene	8.90	1576.0	0.05	10.77	1446.7	0.03
α -Humulene	9.32*	1609.2	[0.90]	10.80	1448.6	0.89
allo-Aromadendrene	9.06	1588.5	0.01	10.89	1455.6	0.02
(<i>E</i>)- β -Farnesene	9.58*	1630.2	[0.18]	10.94*	1459.6	[0.17]
β -Santalene	9.18	1597.7	0.01	10.94*	1459.6	[0.17]
γ -Gurjunene	9.21	1600.4	0.02	11.06	1468.2	0.02
<i>trans</i> -Cadina-1(6),4-diene	9.27	1605.5	0.02	11.09	1470.6	0.03
γ -Muurolole	9.62*	1633.1	[0.08]	11.14*	1473.9	[0.10]
α -Amorphene	9.62*	1633.1	[0.08]	11.14*	1473.9	[0.10]
Germacrene D	9.81	1648.3	0.23	11.17	1476.6	0.27
α -Curcumene	10.69	1720.8	0.06	11.23*	1480.9	[0.25]
β -Selinene	9.90	1655.4	0.24	11.23*	1480.9	[0.25]
α -Selinene	9.97	1661.4	0.16	11.37*	1491.6	[0.47]
epi-Cubebol	12.02	1834.1	0.10	11.37*	1491.6	[0.47]
Bicyclogermacrene	10.09*†	1671.0	[0.17]	11.37*	1491.6	[0.47]
Viridiflorene	9.68*	1637.8	[0.07]	11.37*	1491.6	[0.47]
α -Muurolole	10.09*†	1671.0	[0.17]	11.46	1498.3	0.40
Cubebol	12.58	1883.9	0.16	11.61*	1509.6	[2.16]
γ -Cadinene	10.41	1696.8	0.06	11.61*	1509.6	[2.16]
β -Bisabolene	10.20	1679.7	2.09	11.61*	1509.6	[2.16]
7-epi- α -Selinene	10.46*	1701.4	[1.08]	11.63	1511.1	0.14
<i>trans</i> -Calamenene	11.27	1769.0	0.10	11.76*	1521.8	[1.11]
δ -Cadinene	10.46*	1701.4	[1.08]	11.76*	1521.8	[1.11]
(<i>E</i>)- γ -Bisabolene	10.54	1708.2	0.06	11.85	1528.9	0.04
α -Calacorene	12.17*	1847.6	[0.05]	11.94	1535.4	0.02

(E)- α -Bisabolene	10.75	1725.7	0.04	12.04	1543.8	0.05
Isocaryophyllene epoxide B	12.19	1849.1	0.04	12.07*	1546.1	[0.10]
α -Elemol	14.16	2030.1	0.02	12.07*	1546.1	[0.10]
Germacrene B	11.15	1759.1	0.03	12.13	1550.8	0.04
(E)-Nerolidol	13.82	1998.1	0.05	12.31	1564.8	0.04
Spathulenol	14.44	2056.9	0.11	12.39	1571.5	0.10
Caryophyllene oxide isomer	12.72	1896.7	0.20	12.45*	1576.0	[1.02]
Caryophyllene oxide	12.81	1904.1	0.80	12.45*	1576.0	[1.02]
Unknown MECA III [m/z 161, 105 (84), 43 (80), 119 (72), 93 (62), 121 (54)... 204 (38), 222 (2)]	14.02	2017.1	0.01	12.52	1582.0	0.01
Humulene epoxide I	13.26	1945.8	0.01	12.64	1591.2	0.01
Ledol	13.44	1962.1	0.02	12.70	1595.6	0.03
Humulene epoxide II	13.40	1958.2	0.04	12.77	1601.3	0.05
α -Corocalene	13.71	1987.1	0.02	12.93	1614.7	0.02
Unknown MECA IV [m/z 161, 43 (74), 105 (57), 121 (45), 81 (43)... 204 (31)...]	14.72	2084.3	0.02	12.99	1619.8	0.02
Alismol	15.77	2189.3	0.19	13.04	1624.1	0.20
Caryophylladienol II	16.10	2223.5	0.05	13.11	1629.4	0.04
Isospathulenol	15.48	2159.6	0.01	13.15	1632.8	0.02
τ -Cadinol	14.96	2108.4	0.01	13.20*	1637.3	[0.04]
τ -Muurolol	15.09	2121.3	0.03	13.20*	1637.3	[0.04]
α -Muurolol	15.23*	2135.3	[0.15]	13.26	1641.8	0.13
cis-Calamenen-10-ol	16.49	2263.9	0.04	13.40	1653.4	0.01
trans-Calamenen-10-ol	16.86*	2303.0	[0.03]	13.50	1662.2	0.02
(3Z)-Caryophylla-3,8(13)-dien-5 β -ol	16.86*	2303.0	[0.03]	13.55	1665.7	0.01
Phytone				15.65	1848.6	0.01
meta-Camphorene	15.42	2154.5	0.02	16.76	1952.2	0.01
Total reported		99.24%			99.43%	

*: 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