Date : 2026-05-04

Certificate of Analysis - GC Profiling

Sample Identification

Internal code : 25L16-PTH01
Customer Identification : Black Pepper - India - B40114
Type : Essential Oil
Source : *Piper nigrum*
Customer : Plant Therapy

Checked an approved by:

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

Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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 of the version first issued on 2025-12-18 to make a correction in the sample identification section.

Méthode certifiée ISO 17025:2017 Certified method

Laboratoire PhytoChemia

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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 : 2025-12-17

Physicochemical data

Refractive index : 1.4837 ± 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.

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Analysis Summary - Consolidated Contents

New readers of similar reports are encouraged to read table footnotes at least once.

Identification	%	Class
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Tricyclene	0.03	Monoterpene
α-Thujene	0.36	Monoterpene
α-Pinene	9.49	Monoterpene
Camphene	0.20	Monoterpene
α-Fenchene	0.01	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.02	Monoterpene
Sabinene	9.70	Monoterpene
β-Pinene	8.55	Monoterpene
Dehydro-1,8-cineole	0.01	Monoterpenic ether
Myrcene	1.02	Monoterpene
2-Carene	0.01	Monoterpene
α-Phellandrene	1.34	Monoterpene
Pseudolimonene	0.03	Monoterpene
Δ3-Carene	8.55	Monoterpene
1,4-Cineole	0.01	Monoterpenic ether
α-Terpinene	0.12	Monoterpene
meta-Cymene	0.04	Monoterpene
para-Cymene	0.52	Monoterpene
1,8-Cineole	[0.77]	Monoterpenic ether
Limonene	12.21	Monoterpene
β-Phellandrene	[0.77]	Monoterpene
(*Z*)-β-Ocimene	0.02	Monoterpene
(*E*)-β-Ocimene	0.07	Monoterpene
Unknown	0.03	Monoterpene
γ-Terpinene	0.21	Monoterpene
cis-Sabinene hydrate	0.07	Monoterpenic alcohol
Isoterpinolene	0.14	Monoterpene
para-Cymenene	0.02	Monoterpene
Terpinolene	0.38	Monoterpene
α-Pinene oxide	0.02	Monoterpenic ether
trans-Sabinene hydrate	0.05	Monoterpenic alcohol
Linalool	0.43	Monoterpenic alcohol
Verbenol analog?	0.02	Monoterpenic alcohol
trans-para-Mentha-2,8-dien-1-ol	0.04	Monoterpenic alcohol
cis-Limonene oxide	0.02	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
trans-Limonene oxide	0.01	Monoterpenic ether

trans-para-Menth-2-en-1-ol	0.04	Monoterpenic alcohol
trans-Verbenol	0.01	Monoterpenic alcohol
meta-Mentha-4,6-dien-8-ol	0.02	Monoterpenic alcohol
Pinocarvone	0.03	Monoterpenic ketone
α-Phellandren-8-ol	0.01	Monoterpenic alcohol
cis-Sabinol	0.02	Monoterpenic alcohol
Terpinen-4-ol	0.31	Monoterpenic alcohol
meta-Cymen-8-ol	0.02	Monoterpenic alcohol
para-Cymen-8-ol	0.02	Monoterpenic alcohol
Myrtenal	0.02	Monoterpenic aldehyde
α-Terpineol	0.24	Monoterpenic alcohol
Myrtenol	0.03	Monoterpenic alcohol
cis-α-Phellandrene epoxide (iPr vs Me)	0.03	Monoterpenic ether
trans-Isopiperitenol	0.01	Monoterpenic alcohol
Verbenone	0.04	Monoterpenic ketone
Unknown	tr	Oxygenated monoterpene
Car-2-en-4-one?	0.03	Monoterpenic ketone
trans-Carveol	0.02	Monoterpenic alcohol
cis-Carveol	0.02	Monoterpenic alcohol
Cuminal	0.01	Monoterpenic aldehyde
Carvone	0.02	Monoterpenic ketone
Car-3-en-2-one	0.01	Monoterpenic ketone
Unknown	0.03	Unknown
Bornyl acetate	0.01	Monoterpenic ester
Unknown	0.02	Oxygenated monoterpene
Car-3-en-5-one	0.02	Monoterpenic ketone
Bicycloelemene	0.03	Sesquiterpene
δ-Elemene isomer	0.03	Sesquiterpene
δ-Elemene	2.78	Sesquiterpene
α-Cubebene	0.26	Sesquiterpene
Cyclosativene I	0.06	Sesquiterpene
Cyclosativene II	0.06	Sesquiterpene
α-Copaene	2.69	Sesquiterpene
cis-β-Elemene	0.04	Sesquiterpene
β-Cubebene	0.20	Sesquiterpene
β-Elemene	0.96	Sesquiterpene
Isocaryophyllene	0.05	Sesquiterpene
α-Gurjunene	0.18	Sesquiterpene
β-Caryophyllene	28.02	Sesquiterpene
cis-α-Bergamotene	0.04	Sesquiterpene
β-Copaene	0.14	Sesquiterpene
γ-Elemene	0.03	Sesquiterpene
trans-α-Bergamotene	[0.25]	Sesquiterpene
α-Guaiene	[0.25]	Sesquiterpene
Unknown	0.03	Unknown

Unknown	0.02	Sesquiterpene
α-Humulene	1.54	Sesquiterpene
allo-Aromadendrene	0.03	Sesquiterpene
β-Santalene	tr	Sesquiterpene
(*E*)-β-Farnesene	0.04	Sesquiterpene
γ-Gurjunene	0.03	Sesquiterpene
trans-Cadina-1(6),4-diene	0.05	Sesquiterpene
γ-Muurolene	0.10	Sesquiterpene
α-Amorphene	0.05	Sesquiterpene
Germacrene D	0.52	Sesquiterpene
ar-Curcumene	0.08	Sesquiterpene
β-Selinene	1.11	Sesquiterpene
trans-Muurola-4(15),5-diene	0.07	Sesquiterpene
epi-Cubebol	0.06	Sesquiterpenic alcohol
Bicyclogermacrene	0.14	Sesquiterpene
α-Selinene	0.82	Sesquiterpene
Viridiflorene	0.12	Sesquiterpene
α-Muurolene	0.32	Sesquiterpene
Germacrene A	0.01	Sesquiterpene
β-Bisabolene	0.50	Sesquiterpene
Cubebol	0.07	Sesquiterpenic alcohol
(3*E*,6*E*)-α-Farnesene	0.14	Sesquiterpene
trans-Calamenene	0.04	Sesquiterpene
Zonarene	0.12	Sesquiterpene
δ-Cadinene	0.92	Sesquiterpene
(*E*)-γ-Bisabolene	0.06	Sesquiterpene
α-Cadinene	0.01	Sesquiterpene
α-Calacorene	0.02	Sesquiterpene
(*E*)-α-Bisabolene	0.03	Sesquiterpene
Isocaryophyllene epoxide B	0.04	Sesquiterpenic ether
α-Elemol	0.01	Sesquiterpenic alcohol
Germacrene B	0.08	Sesquiterpene
(*E*)-Nerolidol	0.02	Sesquiterpenic alcohol
Spathulenol	0.03	Sesquiterpenic alcohol
Caryophyllene oxide isomer	0.08	Sesquiterpenic ether
Caryophyllene oxide	0.37	Sesquiterpenic ether
Humulene epoxide II	0.03	Sesquiterpenic ether
α-Corocalene	0.01	Sesquiterpene
Alismol	0.14	Sesquiterpenic alcohol
Caryophylladienol II	0.02	Sesquiterpenic alcohol
τ-Muurolol	0.03	Sesquiterpenic alcohol
α-Muurolol	0.07	Sesquiterpenic alcohol
Consolidated total	**99.41**	

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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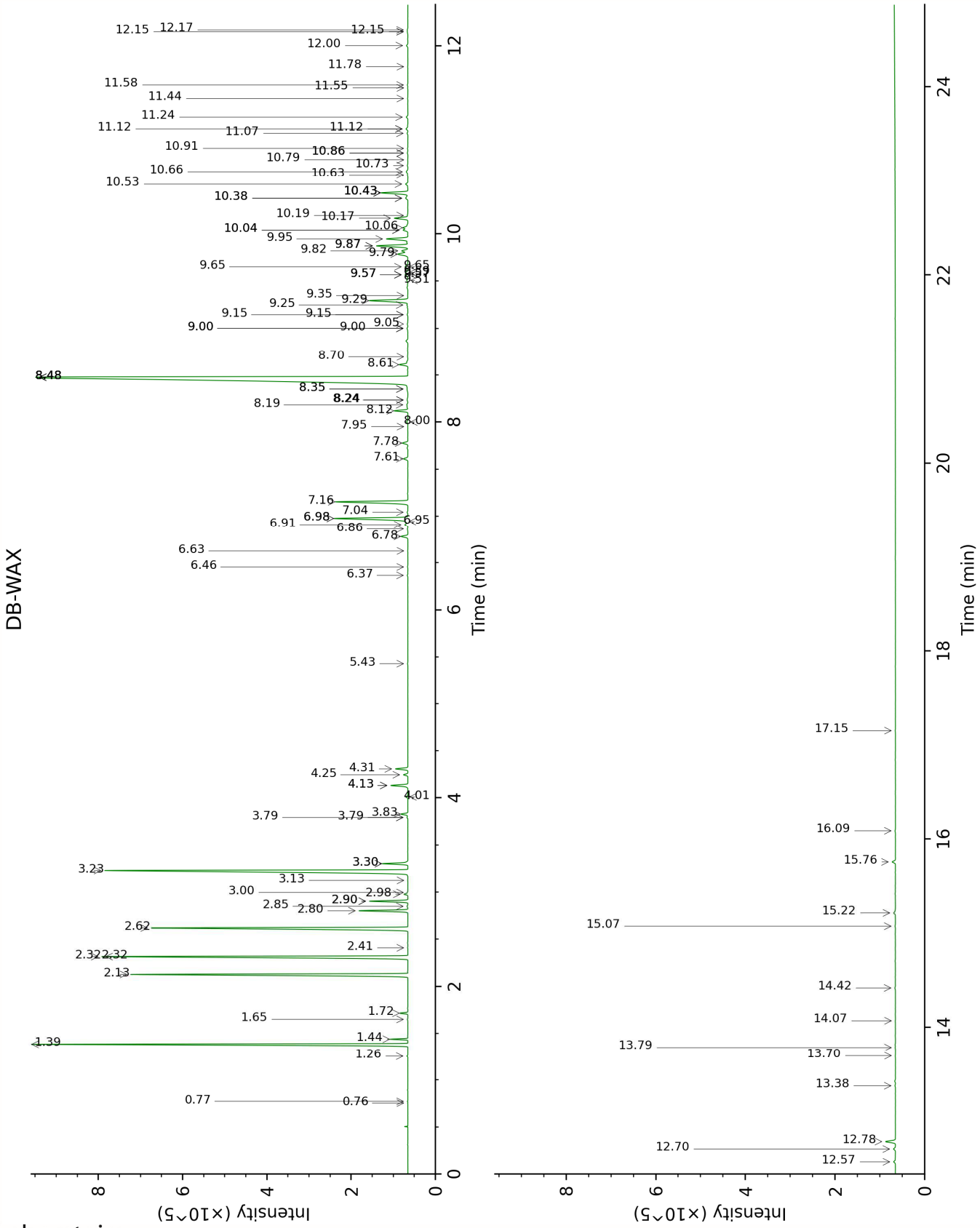
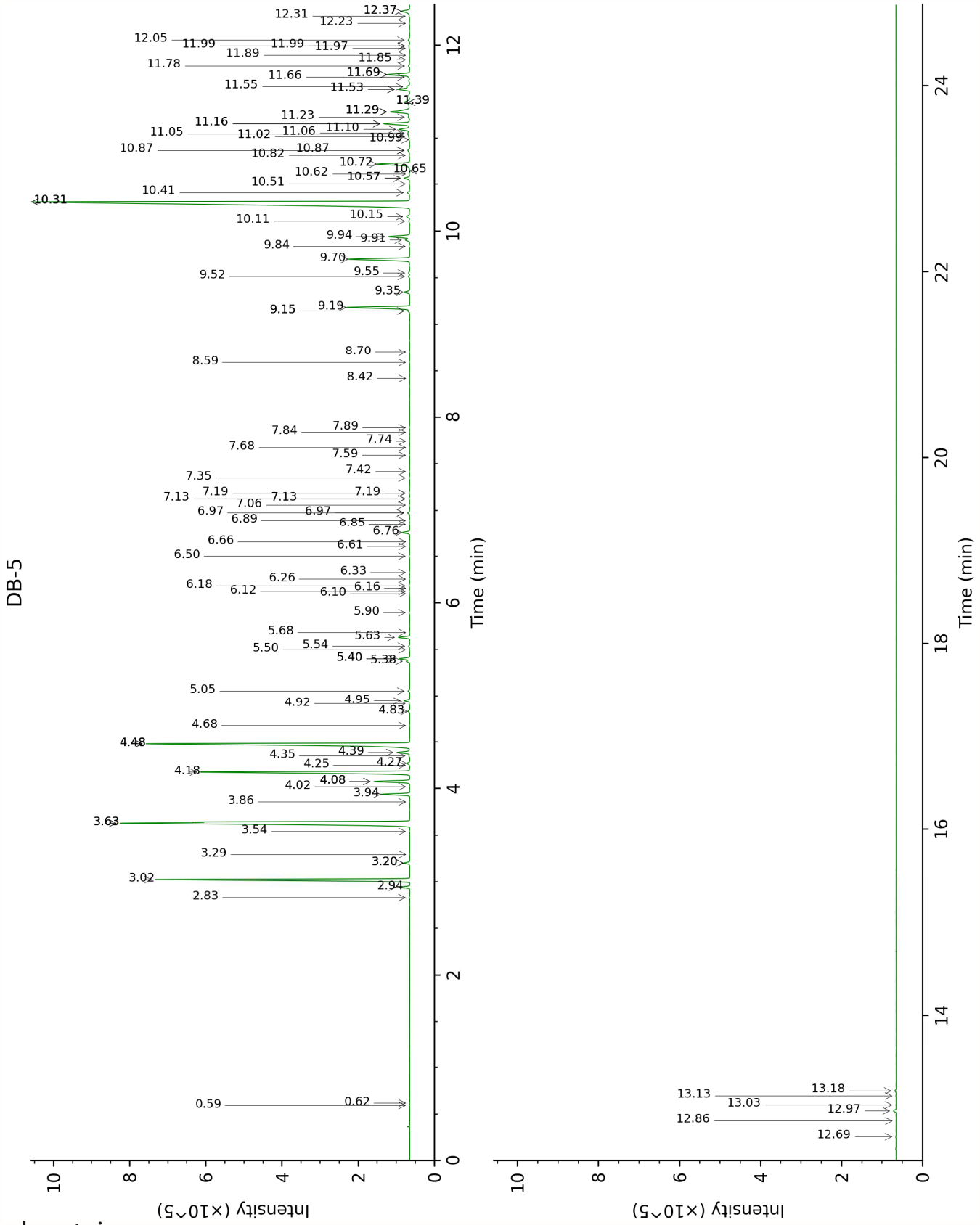

DB-WAX
Time (min)
Intensity (×10^5)
12.15
12.17
12.00
11.78
11.58
11.55
11.44
11.24
11.12
11.07
10.91
10.86
10.79
10.73
10.66
10.63
10.53
10.43
10.38
10.19
10.17
10.06
10.04
9.95
9.87
9.82
9.79
9.65
9.57
9.35
9.29
9.25
9.15
9.05
9.00
8.70
8.61
8.48
8.35
8.24
8.19
8.12
8.00
7.95
7.78
7.61
7.16
7.04
6.98
6.95
6.91
6.86
6.78
6.63
6.46
6.37
5.43
4.31
4.25
4.13
4.01
3.83
3.79
3.30
3.23
3.13
3.00
2.98
2.90
2.85
2.80
2.62
2.41
2.32
2.13
1.72
1.65
1.44
1.39
1.26
0.77
0.76
17.15
16.09
15.76
15.22
15.07
14.42
14.07
13.79
13.70
13.38
12.78
12.70
12.57


DB-5
Intensity (×10^5)
Time (min)
12.31
12.37
12.23
12.05
11.99
11.99
11.97
11.89
11.85
11.78
11.66
11.69
11.55
11.53
11.39
11.23
11.29
11.16
11.05
11.02
11.06
11.10
10.99
10.87
10.82
10.87
10.72
10.62
10.57
10.65
10.51
10.41
10.31
10.11
10.15
9.94
9.91
9.84
9.70
9.52
9.55
9.35
9.15
9.19
8.70
8.59
8.42
7.84
7.89
7.74
7.68
7.59
7.35
7.42
7.13
7.19
7.13
7.19
7.06
6.97
6.97
6.89
6.85
6.76
6.66
6.61
6.50
6.33
6.26
6.18
6.16
6.12
6.10
5.90
5.68
5.63
5.50
5.54
5.40
5.38
5.05
4.92
4.95
4.83
4.68
4.48
4.35
4.39
4.25
4.27
4.18
4.02
4.08
3.94
3.86
3.63
3.54
3.29
3.20
3.02
2.94
2.83
0.59
0.62
13.13
13.18
13.03
12.97
12.86
12.69

FULL ANALYSIS DATA

	Column DB-WAX			Column DB-5		
Isovaleral	0.77	889.3	0.01	0.59	643.5	0.01
2-Methylbutyral	0.76	882.6	tr	0.62	653.0	tr
Tricyclene	1.26	971.7	0.02	2.83	919.0	0.03
α-Thujene	1.44	999.6	0.35	2.94	926.4	0.36
α-Pinene	1.39	993.1	9.49	3.02	932.0	9.49
Camphene	1.72	1027.0	0.20	3.20*	943.8	[0.22]
α-Fenchene	1.65	1020.5	0.01	3.20*	943.8	[0.22]
Thuja-2,4(10)-diene	2.32*	1086.8	[9.66]	3.29	950.0	0.01
3,7,7-Trimethylcyclohepta-1,3,5-triene	2.90*	1135.0	[1.03]	3.54	966.6	0.02
Sabinene	2.32*	1086.8	[9.66]	3.63*	972.6	[18.25]
β-Pinene	2.13	1067.9	8.55	3.63*	972.6	[18.25]
Dehydro-1,8-cineole	3.13	1152.4	tr	3.86	987.9	0.01
Myrcene	2.90*	1135.0	[1.03]	3.94	993.4	1.02
2-Carene	2.41	1096.1	0.01	4.02	998.9	0.01
α-Phellandrene	2.80	1127.1	1.34	4.08*	1002.7	[1.35]
Pseudolimonene	2.85	1130.8	0.03	4.08*	1002.7	[1.35]
Δ3-Carene	2.62	1112.7	8.55	4.18	1009.2	8.55
1,4-Cineole	3.00	1142.3	0.01	4.25	1013.8	0.01
α-Terpinene	2.98	1140.9	0.12	4.27	1015.2	0.12
meta-Cymene	4.13*	1229.6	[0.55]	4.35	1020.3	0.04
para-Cymene	4.13*	1229.6	[0.55]	4.39	1022.5	0.52
1,8-Cineole	3.30*	1166.4	[0.75]	4.48*	1028.5	[12.98]
Limonene	3.23	1160.7	12.21	4.48*	1028.5	[12.98]
β-Phellandrene	3.30*	1166.4	[0.75]	4.48*	1028.5	[12.98]
(*Z*)-β-Ocimene	3.79*	1204.7	[0.04]	4.68	1040.9	0.02
(*E*)-β-Ocimene	4.01	1220.7	0.07	4.83	1050.6	0.07
Unknown CUSE I [m/z 93, 91 (54), 92 (31), 77 (29), 79 (17), 43 (13), 41 (10), 136 (9)]	3.79*	1204.7	[0.04]	4.92	1056.0	0.03
γ-Terpinene	3.83	1207.3	0.22	4.94	1057.9	0.21
cis-Sabinene hydrate	6.91	1428.9	0.13	5.05	1064.8	0.07
Isoterpinolene	4.25	1237.9	0.14	5.38	1085.3	0.14
para-Cymenene	6.37	1389.2	0.02	5.40*	1087.0	[0.40]
Terpinolene	4.31	1242.5	0.38	5.40*	1087.0	[0.40]
α-Pinene oxide	5.43	1322.4	0.02	5.50	1093.2	0.02
trans-Sabinene hydrate	8.00	1509.9	0.05	5.54	1095.6	0.05
Linalool	8.12	1519.0	0.43	5.63	1101.6	0.43
Verbenol analog?	8.35*	1536.8	[0.05]	5.68	1104.9	0.02

trans-para-Mentha-2,8-dien-1-ol	9.00*	1586.8	[0.05]	5.90	1118.8	0.04
cis-Limonene oxide	6.46	1395.5	0.02	6.10	1132.0	0.02
cis-para-Mentha-2,8-dien-1-ol	9.51	1627.2	0.06	6.12	1133.6	0.03
trans-Limonene oxide	6.63	1408.1	0.01	6.16	1135.8	0.01
trans-para-Menth-2-en-1-ol	9.00*	1586.8	[0.05]	6.18	1137.4	0.04
trans-Verbenol	9.57*†	1632.1	[0.14]	6.26	1142.1	0.01
meta-Mentha-4,6-dien-8-ol	9.35	1614.4	0.01	6.33	1146.8	0.02
Pinocarvone	7.95	1506.1	0.01	6.50	1158.1	0.03
α-Phellandren-8-ol	10.19	1682.5	0.02	6.61	1165.0	0.01
cis-Sabinol	10.91	1742.5	0.02	6.66	1168.2	0.02
Terpinen-4-ol	8.61	1556.7	0.31	6.76	1174.7	0.31
meta-Cymen-8-ol	11.55	1796.8	0.01	6.85	1180.9	0.02
para-Cymen-8-ol	11.58	1799.5	0.02	6.89	1183.5	0.02
Myrtenal	8.70	1563.2	0.02	6.98*	1188.9	[0.10]
α-Terpineol	9.82	1652.4	0.24	6.98*	1188.9	[0.10]
Myrtenol	10.86*	1738.3	[0.03]	7.06	1194.3	0.03
cis-α-Phellandrene epoxide (iPr vs Me)	11.07	1756.0	0.03	7.13*	1198.7	[0.04]
trans-Isopiperitenol	10.43*	1702.3	[1.00]	7.13*	1198.7	[0.04]
Verbenone	9.65*	1638.9	[0.17]	7.19*	1202.7	[0.04]
Unknown PINI IV [m/z 109, 91 (100), 81 (88), 94 (75), 119 (74), 96 (73), 41 (63)... 150 (2)]	10.86*	1738.3	[0.03]	7.19*	1202.7	[0.04]
Car-2-en-4-one?	9.57*†	1632.1	[0.14]	7.35	1213.7	0.03
trans-Carveol	11.44	1787.1	0.01	7.42	1218.4	0.02
cis-Carveol	11.78	1816.6	0.01	7.59	1230.3	0.02
Cuminal	10.63	1718.6	0.02	7.68	1236.0	0.01
Carvone	10.04*†	1670.1	[0.18]	7.74	1240.6	0.02
Car-3-en-2-one	10.43*	1702.3	[1.00]	7.84	1247.2	0.01
Unknown CALU IV [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	11.12*	1759.9	[0.08]	7.89	1250.5	0.03
Bornyl acetate	8.24*	1527.9	[0.05]	8.42	1286.8	0.01
Unknown MISC IX [m/z 43, 93 (66), 91 (44), 41 (38), 69 (35)... 152? (1)]				8.59	1298.6	0.02

Car-3-en-5-one	12.15*	1849.3	[0.03]	8.70	1306.3	0.02
Bicycloelemene	7.04	1438.7	0.03	9.15*	1334.7	[0.08]
δ-Elemene isomer	6.86	1425.4	0.03	9.15*	1334.7	[0.08]
δ-Elemene	6.98*	1433.9	[2.83]	9.19	1337.3	2.78
α-Cubebene	6.78	1419.3	0.24	9.35	1348.9	0.26
Cyclosativene I	6.95	1431.4	0.06	9.52	1360.9	0.06
Cyclosativene II	6.98*	1433.9	[2.83]	9.55	1363.5	0.06
α-Copaene	7.16	1446.9	2.70	9.70	1374.0	2.69
cis-β-Elemene	8.35*	1536.8	[0.05]	9.84	1383.7	0.04
β-Cubebene	7.78	1492.8	0.20	9.91	1388.5	0.20
β-Elemene	8.48*	1546.4	[29.49]	9.94	1391.1	0.96
Isocaryophyllene	8.18	1523.9	0.05	10.11	1402.9	0.05
α-Gurjunene	7.61	1480.6	0.17	10.16	1406.3	0.18
β-Caryophyllene	8.48*	1546.4	[29.49]	10.31*	1418.2	[28.06]
cis-α-Bergamotene	8.24*	1527.9	[0.05]	10.31*	1418.2	[28.06]
β-Copaene	8.48*	1546.4	[29.49]	10.41	1425.5	0.14
γ-Elemene	9.05	1590.4	0.03	10.50	1432.5	0.03
trans-α-Bergamotene	8.48*	1546.4	[29.49]	10.57*	1437.2	[0.25]
α-Guaiene	8.48*	1546.4	[29.49]	10.57*	1437.2	[0.25]
Unknown ZIOF XIV [m/z 41, 97 (78), 69 (77), 43 (71), 125 (67), 55 (56)... 168 (39)]	17.15	2338.5	0.02	10.62	1441.0	0.03
Unknown ZIOF XV [m/z 139, 69 (60), 41 (51), 43 (47), 119 (41)... 204 (1)]				10.65	1443.7	0.02
α-Humulene	9.30	1610.1	1.53	10.72	1449.0	1.54
allo-Aromadendrene	9.00*	1586.8	[0.05]	10.82	1456.0	0.03
β-Santalene	9.15*	1598.1	[0.03]	10.87*	1460.0	[0.13]
(*E*)-β-Farnesene	9.57*†	1632.1	[0.14]	10.87*	1460.0	[0.13]
γ-Gurjunene	9.15*	1598.1	[0.03]	10.99	1468.7	0.03
trans-Cadina-1(6),4-diene	9.25	1606.4	0.04	11.02	1471.2	0.05
γ-Muurolene	9.59*†	1634.0	[0.09]	11.05	1473.3	0.10
α-Amorphene	9.57*†	1632.1	[0.14]	11.06	1474.0	0.05
Germacrene D	9.79	1649.6	0.49	11.10	1477.0	0.52
ar-Curcumene	10.66	1721.5	0.08	11.16*	1481.5	[1.20]
β-Selinene	9.87*	1656.7	[1.18]	11.16*	1481.5	[1.20]
trans-Muurola-4(15),5-diene	9.87*	1656.7	[1.18]	11.23	1486.8	0.07
epi-Cubebol	12.00	1836.4	0.06	11.29*	1491.1	[1.14]
Bicyclogermacrene	10.06†	1672.1	0.22	11.29*	1491.1	[1.14]
α-Selinene	9.95	1662.6	0.82	11.29*	1491.1	[1.14]

Viridiflorene	9.65*	1638.9	[0.17]	11.29*	1491.1	[1.14]
α-Muurolene	10.04*†	1670.1	[0.18]	11.39*	1498.8	[0.32]
Germacrene A	10.38*	1697.4	[0.12]	11.39*	1498.8	[0.32]
β-Bisabolene	10.17	1680.2	0.50	11.53*	1509.3	[0.52]
Cubebol	12.57	1886.1	0.07	11.53*	1509.3	[0.52]
(3*E*,6*E*)-α-Farnesene	10.53	1710.1	0.09	11.56	1511.6	0.14
trans-Calamenene	11.24	1770.5	0.06	11.66	1519.7	0.04
Zonarene	10.38*	1697.4	[0.12]	11.69*	1521.9	[1.04]
δ-Cadinene	10.43*	1702.3	[1.00]	11.69*	1521.9	[1.04]
(*E*)-γ-Bisabolene	10.43*	1702.3	[1.00]	11.78	1529.1	0.06
α-Cadinene	10.79	1732.3	0.01	11.84	1534.4	0.01
α-Calacorene	12.17	1851.0	0.03	11.89	1538.2	0.02
(*E*)-α-Bisabolene	10.73	1727.1	0.02	11.97	1544.1	0.03
Isocaryophyllene epoxide B	12.15*	1849.3	[0.03]	11.99*	1546.1	[0.05]
α-Elemol	14.07	2025.8	0.01	11.99*	1546.1	[0.05]
Germacrene B	11.12*	1759.9	[0.08]	12.06	1551.0	0.08
(*E*)-Nerolidol	13.79	1998.5	0.01	12.23	1565.2	0.02
Spathulenol	14.42	2059.3	0.03	12.31	1571.3	0.03
Caryophyllene oxide isomer	12.70	1898.4	0.08	12.37*	1575.6	[0.45]
Caryophyllene oxide	12.78	1905.7	0.37	12.37*	1575.6	[0.45]
Humulene epoxide II	13.38	1960.2	0.02	12.69	1601.3	0.03
α-Corocalene	13.70	1989.8	0.01	12.86	1615.1	0.01
Alismol	15.76	2191.9	0.13	12.97	1624.1	0.14
Caryophylladienol II	16.09	2226.2	0.03	13.03	1629.4	0.02
τ-Muurolol	15.08	2123.6	0.02	13.13	1637.4	0.03
α-Muurolol	15.22	2137.7	0.09	13.18	1641.9	0.07
Total reported		99.12%			99.29%	

*: 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