

Date : 2025-12-22

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 25K20-PTH02

Customer Identification : Black Pepper - India- B40113R

Type : Essential Oil

Source : *Piper nigrum*

Customer : Plant Therapy

Checked and 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Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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 2025-11-24 to make a correction in the sample identification section.

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 : 2025-11-24

PHYSICOCHEMICAL DATA

Refractive index : 1.4813 ± 0.0003 (20 °C)

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

Analyst : Cindy Caron B. Sc.

Date : 2025-11-24

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	tr	Simple phenolic
Tricyclene	0.02	Monoterpene
α -Thujene	0.70	Monoterpene
α -Pinene	10.61	Monoterpene
α -Fenchene	0.01	Monoterpene
Camphene	0.25	Monoterpene
Thuja-2,4(10)-diene	0.01	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.02	Monoterpene
β -Pinene	11.34	Monoterpene
Sabinene	10.74	Monoterpene
Dehydro-1,8-cineole	0.01	Monoterpenic ether
Myrcene	1.59	Monoterpene
2-Carene	0.01	Monoterpene
α -Phellandrene	1.42	Monoterpene
Pseudolimonene	0.03	Monoterpene
Δ^3 -Carene	7.32	Monoterpene
α -Terpinene	0.10	Monoterpene
<i>meta</i> -Cymene	0.03	Monoterpene
<i>para</i> -Cymene	0.35	Monoterpene
Limonene	14.07	Monoterpene
β -Phellandrene	1.35	Monoterpene
(Z)- β -Ocimene	0.02	Monoterpene
(E)- β -Ocimene	0.15	Monoterpene
γ -Terpinene	0.19	Monoterpene
<i>cis</i> -Sabinene hydrate	0.11	Monoterpenic alcohol
Isoterpinolene	0.12	Monoterpene
Terpinolene	0.41	Monoterpene
<i>para</i> -Cymenene	0.01	Monoterpene
α -Pinene oxide	0.04	Monoterpenic ether
<i>trans</i> -Sabinene hydrate	0.06	Monoterpenic alcohol
Unknown	0.01	Unknown
Linalool	0.35	Monoterpenic alcohol
Verbenol analog?	0.01	Monoterpenic alcohol
<i>trans-para</i> -Mentha-2,8-dien-1-ol	0.04	Monoterpenic alcohol
<i>cis</i> -Limonene oxide	0.03	Monoterpenic ether
<i>cis-para</i> -Mentha-2,8-dien-1-ol	0.05	Monoterpenic alcohol
<i>trans</i> -Limonene oxide	0.02	Monoterpenic ether
<i>trans-para</i> -Menth-2-en-1-ol	0.03	Monoterpenic alcohol
<i>trans</i> -Verbenol	0.04	Monoterpenic alcohol

1,4-Dimethyl-4-acetylcyclohexene	0.01	Monoterpenic ketone
<i>meta</i> -Mentha-4,6-dien-8-ol	0.01	Monoterpenic alcohol
Sabinaketone	0.02	Normonoterpenic ketone
Pinocarvone	0.02	Monoterpenic ketone
<i>cis</i> -Sabinol	0.02	Monoterpenic alcohol
Terpinen-4-ol	0.41	Monoterpenic alcohol
Cryptone	0.02	Normonoterpenic ketone
<i>meta</i> -Cymen-8-ol	0.02	Monoterpenic alcohol
<i>para</i> -Cymen-8-ol	0.01	Monoterpenic alcohol
α -Terpineol	0.06	Monoterpenic alcohol
Myrtenal	0.02	Monoterpenic aldehyde
Myrtenol	0.05	Monoterpenic alcohol
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	0.03	Monoterpenic ether
Verbenone	0.03	Monoterpenic ketone
Car-2-en-4-one?	0.02	Monoterpenic ketone
<i>trans</i> -Carveol	0.03	Monoterpenic alcohol
<i>cis</i> -Carveol	0.03	Monoterpenic alcohol
Cuminal	0.02	Monoterpenic aldehyde
Carvone	0.04	Monoterpenic ketone
Unknown	0.03	Unknown
<i>trans</i> -Ascaridole glycol	0.01	Monoterpenic alcohol
Cuminol	0.01	Monoterpenic alcohol
Unknown	0.01	Oxygenated monoterpene
<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	0.01	Monoterpenic alcohol
Methyl geranate	0.01	Monoterpenic ester
δ -Elemene isomer	0.01	Sesquiterpene
Bicycloelemene	0.05	Sesquiterpene
δ -Elemene	1.72	Sesquiterpene
α -Cubebene	0.19	Sesquiterpene
Cyclosativene I	0.07	Sesquiterpene
Cyclosativene II	0.02	Sesquiterpene
α -Ylangene	0.01	Sesquiterpene
α -Copaene	2.94	Sesquiterpene
β -Bourbonene	0.01	Sesquiterpene
<i>cis</i> - β -Elemene	0.03	Sesquiterpene
β -Cubebene	0.28	Sesquiterpene
β -Elemene	0.35	Sesquiterpene
Isocaryophyllene	0.03	Sesquiterpene
α -Gurjunene	0.10	Sesquiterpene
β -Caryophyllene	24.73	Sesquiterpene
<i>cis</i> - α -Bergamotene	0.02	Sesquiterpene
β -Copaene	0.14	Sesquiterpene
γ -Elemene	0.01	Sesquiterpene
<i>trans</i> - α -Bergamotene	[0.11]	Sesquiterpene

α -Guaiane	[0.11]	Sesquiterpene
Unknown	0.02	Unknown
Unknown	0.01	Sesquiterpene
<i>trans</i> -Muuroala-3,5-diene	0.05	Sesquiterpene
α -Humulene	0.96	Sesquiterpene
allo-Aromadendrene	0.02	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.14	Sesquiterpene
γ -Gurjunene	0.02	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.03	Sesquiterpene
γ -Muurolene	0.04	Sesquiterpene
Germacrene D	0.32	Sesquiterpene
β -Selinene	0.27	Sesquiterpene
ar-Curcumene	0.05	Sesquiterpene
<i>trans</i> -Muuroala-4(15),5-diene	0.05	Sesquiterpene
Bicyclogermacrene	0.12	Sesquiterpene
α -Selinene	0.23	Sesquiterpene
epi-Cubebol	0.08	Sesquiterpenic alcohol
Viridiflorene	0.04	Sesquiterpene
α -Muurolene	0.25	Sesquiterpene
Germacrene A	0.11	Sesquiterpene
β -Bisabolene	1.02	Sesquiterpene
Cubebol	0.12	Sesquiterpenic alcohol
γ -Cadinene	tr	Sesquiterpene
δ -Cadinene	0.91	Sesquiterpene
<i>trans</i> -Calamenene	0.05	Sesquiterpene
(<i>E</i>)- γ -Bisabolene	0.04	Sesquiterpene
α -Calacorene	0.01	Sesquiterpene
(<i>E</i>)- α -Bisabolene	0.03	Sesquiterpene
α -Elemol	tr	Sesquiterpenic alcohol
Isocaryophyllene epoxide B	0.04	Sesquiterpenic ether
Germacrene B	0.04	Sesquiterpene
(<i>E</i>)-Nerolidol	0.03	Sesquiterpenic alcohol
Spathulenol	0.03	Sesquiterpenic alcohol
Caryophyllene oxide	0.40	Sesquiterpenic ether
Caryophyllene oxide isomer	0.10	Sesquiterpenic ether
Unknown	0.01	Oxygenated sesquiterpene
Humulene epoxide I	0.02	Sesquiterpenic ether
Humulene epoxide II	0.02	Sesquiterpenic ether
α -Corocalene	0.01	Sesquiterpene
Caryophylladienol I	0.01	Sesquiterpenic alcohol
Alismol	0.13	Sesquiterpenic alcohol
Caryophylladienol II	0.02	Sesquiterpenic alcohol
Isospathulenol	0.01	Sesquiterpenic alcohol
τ -Cadinol	0.01	Sesquiterpenic alcohol
τ -Muurolol	0.02	Sesquiterpenic alcohol

Consolidated total	99.34	
---------------------------	--------------	--

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

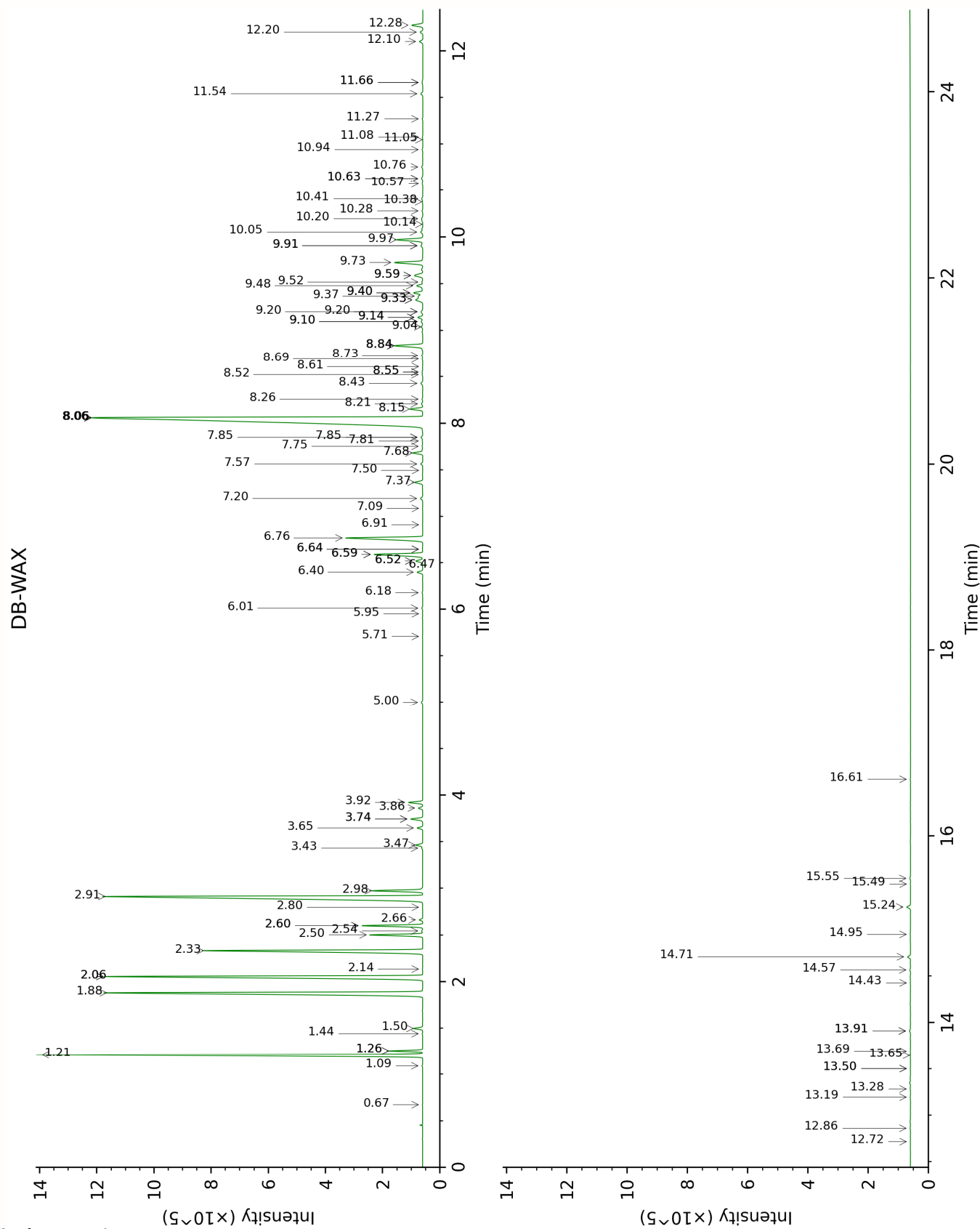
Note: no correction factor was applied

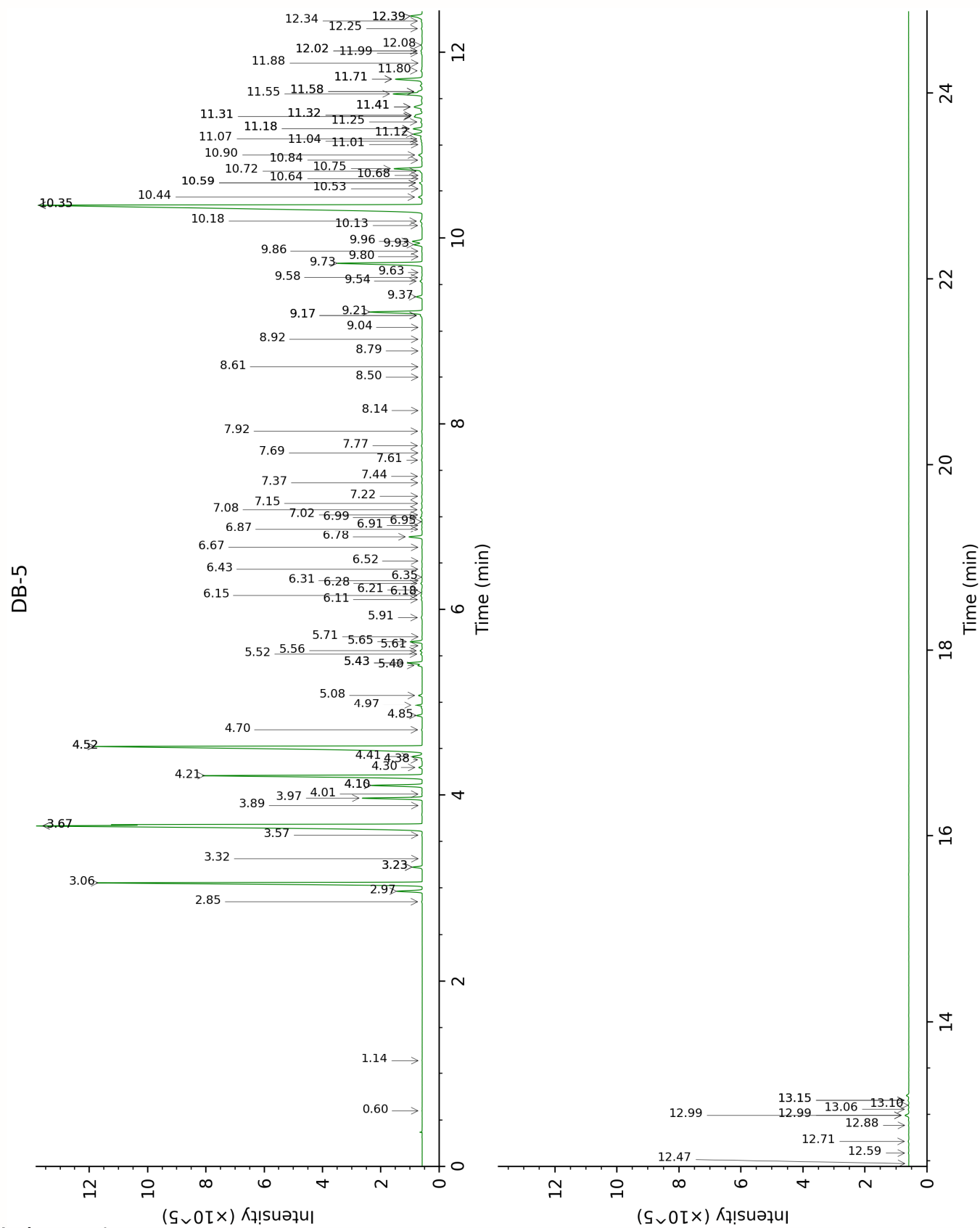
About "consolidated" data: The table above presents the breakdown of the sample volatile constituents after applying an algorithm to collapse data acquired from the multi-columns system of PhytoChemia into a single set of consolidated contents. In case of discrepancies between columns, the algorithm 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		
	0.67	888.1	tr	0.60	643.5	tr
Toluene	1.26*	1002.5	[0.70]	1.14	759.1	tr
Tricyclene	1.09	973.7	0.02	2.85	919.2	0.02
α -Thujene	1.26*	1002.5	[0.70]	2.97	926.7	0.70
α -Pinene	1.21	994.8	10.59	3.06	932.8	10.61
α -Fenchene	1.44	1024.3	0.01	3.23*	944.1	[0.26]
Camphene	1.50	1030.1	0.25	3.23*	944.1	[0.26]
Thuja-2,4(10)-diene	2.06*	1087.4	[10.61]	3.32	950.1	0.01
3,7,7-Trimethylcyclohepta-1,3,5-triene	2.60*	1135.7	[1.59]	3.57	967.0	0.02
β -Pinene	1.88	1069.3	11.34	3.67*†	973.7	[17.82]
Sabinene	2.06*	1087.4	[10.61]	3.67*†	973.7	[17.82]
Dehydro-1,8-cineole	2.80	1151.5	0.01	3.89	988.3	0.01
Myrcene	2.60*	1135.7	[1.59]	3.97	993.7	1.59
2-Carene	2.14	1095.5	0.01	4.01	996.6	0.01
α -Phellandrene	2.50	1127.8	1.42	4.10*	1002.9	[1.45]
Pseudolimonene	2.54	1131.1	0.03	4.10*	1002.9	[1.45]
Δ^3 -Carene	2.33	1114.3	7.28	4.21	1009.7	7.32
α -Terpinene	2.66	1140.7	0.09	4.30	1015.2	0.10
<i>meta</i> -Cymene	3.74*	1226.3	[0.36]	4.38	1020.4	0.03
<i>para</i> -Cymene	3.74*	1226.3	[0.36]	4.41	1022.6	0.35
Limonene	2.91	1160.8	14.07	4.52*	1029.5	[15.49]
β -Phellandrene	2.98	1165.8	1.35	4.52*	1029.5	[15.49]
(Z)- β -Ocimene	3.43	1202.6	0.03	4.70	1040.8	0.02
(E)- β -Ocimene	3.65	1219.2	0.15	4.85	1050.6	0.15
γ -Terpinene	3.47	1205.4	0.21	4.97	1057.9	0.19
<i>cis</i> -Sabinene hydrate	6.52*	1429.6	[0.24]	5.08	1064.7	0.11
Isoterpinolene	3.86	1235.1	0.13	5.40	1085.2	0.12
Terpinolene	3.92	1239.6	0.41	5.43*	1086.9	[0.43]
<i>para</i> -Cymenene	5.95	1387.2	0.01	5.43*	1086.9	[0.43]
α -Pinene oxide	5.00	1317.0	0.04	5.52	1092.9	0.04
<i>trans</i> -Sabinene hydrate	7.56	1509.4	0.06	5.56	1095.3	0.06
Unknown PINI III [m/z 109, 43 (65), 95 (54), 119 (50), 91 (47)... 149 (8)...]	5.71	1369.3	0.01	5.61	1098.7	0.01
Linalool	7.68	1518.7	0.31	5.65	1101.4	0.35
Verbenol analog?	7.85*	1532.0	[0.06]	5.71	1104.8	0.01
<i>trans-para</i> -Mentha-2,8-dien-1-ol	8.52	1585.4	0.02	5.91	1118.1	0.04
<i>cis</i> -Limonene oxide	6.01	1391.7	0.03	6.11	1130.6	0.03

<i>cis-para</i> -Mentha-2,8-dien-1-ol	9.04	1627.1	0.06	6.15	1133.5	0.05
<i>trans</i> -Limonene oxide	6.18	1403.9	0.02	6.18	1135.5	0.02
<i>trans-para</i> -Menth-2-en-1-ol	8.55*	1587.5	[0.03]	6.21	1137.4	0.03
<i>trans</i> -Verbenol	9.10*	1631.7	[0.06]	6.28	1141.9	0.04
1,4-Dimethyl-4-acetylcyclohexene	6.91	1459.8	0.01	6.31	1143.8	0.01
<i>meta</i> -Mentha-4,6-dien-8-ol	8.84*	1610.5	[1.01]	6.35	1146.3	0.01
Sabinaketone	8.26	1564.5	0.03	6.43	1151.8	0.02
Pinocarvone	7.50	1504.1	0.01	6.52	1157.6	0.02
<i>cis</i> -Sabinol	10.38	1738.9	0.02	6.67	1167.1	0.02
Terpinen-4-ol	8.15	1556.1	0.40	6.78	1174.5	0.41
Cryptone	8.73	1602.0	0.04	6.87	1180.2	0.02
<i>meta</i> -Cymen-8-ol	11.05	1797.1	0.01	6.91	1182.9	0.02
<i>para</i> -Cymen-8-ol	11.08	1799.4	0.02	6.95	1185.5	0.01
α -Terpineol	9.37	1654.3	0.13	6.99	1188.3	0.06
Myrtenal	8.21	1560.4	0.05	7.02	1190.2	0.02
Myrtenol	10.41	1741.7	0.04	7.08	1193.9	0.05
<i>cis</i> - α -Phellandrene epoxide (iPr vs Me)	10.57	1755.7	0.03	7.15	1198.3	0.03
Verbenone	9.20*	1640.5	[0.08]	7.22	1203.3	0.03
Car-2-en-4-one?	9.10*	1631.7	[0.06]	7.37	1213.0	0.02
<i>trans</i> -Carveol	10.94	1787.8	0.03	7.44	1217.7	0.03
<i>cis</i> -Carveol	11.27	1816.5	0.02	7.61	1229.5	0.03
Cuminal	10.14	1718.0	0.01	7.69	1234.8	0.02
Carvone	9.52	1666.7	0.03	7.77	1240.1	0.04
Unknown CALU IV [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	10.63*	1760.8	[0.06]	7.92	1250.7	0.03
<i>trans</i> -Ascaridole glycol	13.69	2041.5	0.01	8.14	1265.9	0.01
Cuminol	13.65	2037.1	0.01	8.50	1290.4	0.01
Unknown MISC IX [m/z 43, 93 (66), 91 (44), 41 (38), 69 (35)... 152? (1)]				8.61	1298.0	0.01
<i>para</i> -Menth-5-en-1,2-diol isomer II	13.91*	2062.9	[0.04]	8.79	1306.8	0.01
<i>para</i> -Menth-5-en-1,2-diol isomer III	14.71	2141.9	0.10	8.92	1315.8	0.01
Methyl geranate	9.33*	1650.9	[0.40]	9.04	1324.8	0.01

δ-Elemene isomer	6.47	1425.8	0.01	9.17*	1333.9	[0.06]
Bicycloelemene	6.64*	1439.2	[0.02]	9.17*	1333.9	[0.06]
δ-Elemene	6.59*	1435.0	[1.72]	9.21	1336.6	1.72
α-Cubebene	6.40	1420.5	0.19	9.37	1348.2	0.19
Cyclosativene I	6.52*	1429.6	[0.24]	9.54	1360.1	0.07
Cyclosativene II	6.59*	1435.0	[1.72]	9.58	1362.8	0.02
α-Ylangene	6.64*	1439.2	[0.02]	9.63	1366.7	0.01
α-Copaene	6.76	1448.4	2.95	9.73	1373.8	2.94
β-Bourbonene	7.09	1473.2	0.01	9.80	1378.8	0.01
cis-β-Elemene	7.85*	1532.0	[0.06]	9.86	1383.0	0.03
β-Cubebene	7.37	1494.4	0.28	9.93	1388.0	0.28
β-Elemene	8.06*	1548.7	[25.46]	9.96	1390.5	0.35
Isocaryophyllene	7.75	1524.3	0.03	10.13	1402.5	0.03
α-Gurjunene	7.20	1481.2	0.08	10.18	1405.9	0.10
β-Caryophyllene	8.06*	1548.7	[25.46]	10.35*	1418.6	[24.75]
cis-α-Bergamotene	7.81	1528.8	0.02	10.35*	1418.6	[24.75]
β-Copaene	8.06*	1548.7	[25.46]	10.44	1425.2	0.14
γ-Elemene	8.61	1592.2	0.01	10.53	1431.9	0.01
trans-α-Bergamotene	8.06*	1548.7	[25.46]	10.59*	1436.6	[0.11]
α-Guaiene	8.06*	1548.7	[25.46]	10.59*	1436.6	[0.11]
Unknown ZIOF XIV [m/z 41, 97 (78), 69 (77), 43 (71), 125 (67), 55 (56)... 168 (39)]	16.61	2340.5	0.01	10.64	1440.5	0.02
Unknown ZIOF XV [m/z 139, 69 (60), 41 (51), 43 (47), 119 (41)... 204 (1)]				10.68	1443.2	0.01
trans-Muurolo-3,5- diene	8.43	1577.9	0.08	10.72	1446.6	0.05
α-Humulene	8.84*	1610.5	[1.01]	10.75	1448.6	0.96
allo-Aromadendrene	8.55*	1587.5	[0.03]	10.84	1455.5	0.02
(E)-β-Farnesene	9.14*	1635.5	[0.17]	10.90	1459.6	0.14
γ-Gurjunene	8.69	1598.9	0.02	11.01	1468.0	0.02
trans-Cadina-1(6),4- diene	8.84*	1610.5	[1.01]	11.04	1470.8	0.03
γ-Muurolole	9.14*	1635.5	[0.17]	11.07	1472.6	0.04
Germacrene D	9.33*	1650.9	[0.40]	11.12	1476.5	0.32
β-Selinene	9.40*	1657.2	[0.32]	11.18*	1480.8	[0.32]
ar-Curcumene	10.20	1723.2	0.05	11.18*	1480.8	[0.32]
trans-Muurolo- 4(15),5-diene	9.40*	1657.2	[0.32]	11.25	1486.3	0.05
Bicyclgermacrene	9.59*	1672.5	[0.37]	11.31*†	1490.6	[0.29]
α-Selinene	9.48	1663.5	0.23	11.31*†	1490.6	[0.29]

epi-Cubebol	11.54	1840.8	0.08	11.32*†	1491.7	[0.18]
Viridiflorene	9.20*	1640.5	[0.08]	11.32*†	1491.7	[0.18]
α-Muurolene	9.59*	1672.5	[0.37]	11.41*	1498.4	[0.36]
Germacrene A	9.91*	1698.9	[0.09]	11.41*	1498.4	[0.36]
β-Bisabolene	9.73	1684.1	0.98	11.55	1509.0	1.02
Cubebol	12.10	1891.5	0.12	11.58*	1511.0	[0.10]
γ-Cadinene	9.91*	1698.9	[0.09]	11.58*	1511.0	[0.10]
δ-Cadinene	9.97	1704.2	0.91	11.71*	1521.6	[0.95]
trans-Calamenene	10.76	1771.7	0.05	11.71*	1521.6	[0.95]
(E)-γ-Bisabolene	10.05	1711.0	0.08	11.80	1528.6	0.04
α-Calacorene	11.66*	1851.7	[0.05]	11.88	1535.2	0.01
(E)-α-Bisabolene	10.28	1730.5	0.03	11.99	1543.5	0.03
α-Elemol	13.50*	2022.8	[0.01]	12.02*	1545.6	[0.05]
Isocaryophyllene epoxide B	11.66*	1851.7	[0.05]	12.02*	1545.6	[0.05]
Germacrene B	10.63*	1760.8	[0.06]	12.08	1550.5	0.04
(E)-Nerolidol	13.28	2001.9	0.01	12.25	1564.5	0.03
Spathulenol	13.91*	2062.9	[0.04]	12.34	1571.0	0.03
Caryophyllene oxide	12.28	1907.3	0.40	12.39*	1575.3	[0.49]
Caryophyllene oxide isomer	12.20	1900.6	0.10	12.39*	1575.3	[0.49]
Unknown MECA III [m/z 161, 105 (84), 43 (80), 119 (72), 93 (62), 121 (54)... 204 (38), 222 (2)]	13.50*	2022.8	[0.01]	12.47	1581.7	0.01
Humulene epoxide I	12.72	1948.5	0.01	12.58	1590.7	0.02
Humulene epoxide II	12.86	1962.1	0.02	12.71	1600.6	0.02
α-Corocalene	13.19	1993.5	0.01	12.88	1614.6	0.01
Caryophylladienol I	15.49	2221.5	0.01	12.99*	1623.6	[0.13]
Alismol	15.24	2196.3	0.13	12.99*	1623.6	[0.13]
Caryophylladienol II	15.55	2227.9	0.03	13.06	1629.0	0.02
Isospathulenol	14.95	2166.4	0.01	13.10	1632.7	0.01
τ-Cadinol	14.43	2113.5	0.01	13.15*	1637.0	[0.03]
τ-Muurolol	14.57	2127.5	0.02	13.15*	1637.0	[0.03]
Total reported		99.35%			95.12%	

*: 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