

Date : November 23, 2020

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 20K20-PTH10


Customer identification : Black Pepper ORGANIC - BS0104202R

Type : Essential oil

Source : *Piper nigrum*

Customer : Plant Therapy

ANALYSIS

Method: PC-MAT-014  - Analysis of the composition of an essential oil or other volatile liquid by FAST GC-FID (in French); identifications validated by GC-MS.

Analyst : Sylvain Mercier, M. Sc., Chimiste

Analysis date : November 23, 2020

Checked and approved by :

Alexis St-Gelais, M. Sc., chimiste 2013-174

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PHYSICOCHEMICAL DATA

Physical aspect: Clear liquid

Refractive index: 1.4806 ± 0.0003 (20 °C; method PC-MAT-016)

ISO 3061:2008 - OIL OF BLACK PEPPER - INDIA

Compound	Min. %	Max. %	Observed %	Complies?
Caryophyllene oxide		1.0	0.4	Yes
α-Selinene		3.0	0.2	Yes
β-Selinene	0.5	3.5	0.3	No
Germacrene D		2.0	0.3	Yes
β-Caryophyllene	12	29	22	Yes
α-Copaene	0.5	4.5	2.1	Yes
δ-Elemene	0.5	3.5	1.4	Yes
Limonene	10	17	13	Yes
Δ ³ -Carene	3	15	9	Yes
Sabinene	6	15	11	Yes
β-Pinene	5	12	10	Yes
α-Pinene	3	12	13	No
Refractive index	1.4780	1.4870	1.4806	Yes

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	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	Aliphatic aldehyde
Toluene	tr	Simple phenolic
Tricyclene	0.01	Monoterpene
α -Thujene	1.46	Monoterpene
α -Pinene	13.39	Monoterpene
Camphene	0.35	Monoterpene
α -Fenchene	0.01	Monoterpene
meta-Cymene	0.01	Monoterpene
β -Pinene	10.40	Monoterpene
Sabinene	10.64	Monoterpene
Myrcene	1.98	Monoterpene
2-Carene	0.01	Monoterpene
α -Phellandrene	1.53	Monoterpene
Pseudolimonene	0.04	Monoterpene
Δ^3 -Carene	9.00	Monoterpene
α -Terpinene	0.14	Monoterpene
ortho-Cymene	0.02	Monoterpene
para-Cymene	0.42	Monoterpene
Limonene	13.40	Monoterpene
β -Phellandrene	1.59	Monoterpene
(Z)- β -Ocimene	0.02	Monoterpene
(E)- β -Ocimene	0.17	Monoterpene
γ -Terpinene	0.23	Monoterpene
cis-Sabinene hydrate	0.07	Monoterpenic alcohol
Isoterpinolene	0.10	Monoterpene
para-Cymenene	0.02	Monoterpene
Terpinolene	0.38	Monoterpene
trans-Sabinene hydrate	0.04	Monoterpenic alcohol
Unknown	0.01	Unknown
Linalool	0.27	Monoterpenic alcohol
Verbenol analog?	0.01	Monoterpenic alcohol
trans-para-Mentha-2,8-dien-1-ol	0.03	Monoterpenic alcohol
cis-Limonene oxide	0.01	Monoterpenic ether
cis-para-Mentha-2,8-dien-1-ol	0.02	Monoterpenic alcohol
trans-para-Menth-2-en-1-ol	0.02	Monoterpenic alcohol
trans-Verbenol	0.02	Monoterpenic alcohol
Pinocarvone	0.02	Monoterpenic ketone
Terpinen-4-ol	0.32	Monoterpenic alcohol
Cryptone	0.01	Normonoterpenic ketone
meta-Cymen-8-ol	tr	Monoterpenic alcohol
para-Cymen-8-ol	0.01	Monoterpenic alcohol
α -Terpineol	0.07	Monoterpenic alcohol
Myrtanal	0.02	Monoterpenic aldehyde
Unknown	0.02	Oxygenated monoterpene

Unknown	0.02	Oxygenated monoterpene
Verbenone	0.03	Monoterpenic ketone
Car-2-en-4-one?	0.02	Monoterpenic ketone
<i>trans</i> -Carveol	0.02	Monoterpenic alcohol
<i>cis</i> -Carveol	0.02	Monoterpenic alcohol
Cuminal	0.01	Monoterpenic aldehyde
Carvone	0.01	Monoterpenic ketone
Unknown	0.03	Unknown
Methyl citronellate	0.01	Monoterpenic ester
Unknown	0.01	Oxygenated monoterpene
Car-3-en-5-one	0.02	Monoterpenic ketone
Methyl geranate	0.01	Monoterpenic ester
Bicycloelemene	0.01	Sesquiterpene
δ -Elemene isomer	0.01	Sesquiterpene
δ -Elemene	1.35	Sesquiterpene
α -Cubebene	0.14	Sesquiterpene
Cyclosativene I	0.06	Sesquiterpene
Cyclosativene II	0.02	Sesquiterpene
α -Ylangene	0.01	Sesquiterpene
α -Copaene	2.12	Sesquiterpene
<i>cis</i> - β -Elemene	0.02	Sesquiterpene
β -Cubebene	0.22	Sesquiterpene
β -Elemene	0.34	Sesquiterpene
Unknown	0.01	Unknown
Isocaryophyllene	0.02	Sesquiterpene
α -Gurjunene	0.06	Sesquiterpene
<i>cis</i> - α -Bergamotene	tr	Sesquiterpene
β -Caryophyllene	21.76	Sesquiterpene
β -Copaene	0.13	Sesquiterpene
α -Guaiene	0.09*	Sesquiterpene
<i>trans</i> - α -Bergamotene	[0.09]*	Sesquiterpene
Unknown	0.01	Unknown
Unknown	0.05	Sesquiterpene
α -Humulene	1.04	Sesquiterpene
allo-Aromadendrene	0.02	Sesquiterpene
(<i>E</i>)- β -Farnesene	0.09	Sesquiterpene
β -Santalene	0.01	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.04	Sesquiterpene
γ -Muurolene	0.05	Sesquiterpene
Germacrene D	0.29	Sesquiterpene
β -Selinene	0.32	Sesquiterpene
ar-Curcumene	0.05	Sesquiterpene
<i>trans</i> -Muurola-4(15),5-diene	0.05	Sesquiterpene
α -Selinene	0.22	Sesquiterpene
Bicyclogermacrene	0.03	Sesquiterpene
Viridiflorene	0.04	Sesquiterpene
epi-Cubebol	0.12	Sesquiterpenic alcohol
α -Muurolene	0.41	Sesquiterpene
Cubebol	0.22	Sesquiterpenic alcohol
γ -Cadinene	0.08	Sesquiterpene
β -Bisabolene	0.79	Sesquiterpene
7-epi- α -Selinene	0.13	Sesquiterpene

δ-Cadinene	0.87	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	0.02	Sesquiterpene
Isocaryophyllene epoxide B	0.04	Sesquiterpenic ether
α-Elemol	0.02	Sesquiterpenic alcohol
Unknown	0.04	Aliphatic alcohol
(<i>E</i>)-Nerolidol	0.09	Sesquiterpenic alcohol
Spathulenol	0.05	Sesquiterpenic alcohol
Caryophyllene oxide	0.43	Sesquiterpenic ether
Caryophyllene oxide isomer	0.09	Sesquiterpenic ether
Humulene epoxide II	0.03	Sesquiterpenic ether
α-Corocalene	0.02	Sesquiterpene
Caryophylladienol I	0.02	Sesquiterpenic alcohol
Alismol	0.18	Sesquiterpenic alcohol
τ-Muurolol	0.05	Sesquiterpenic alcohol
τ-Cadinol	0.01	Sesquiterpenic alcohol
α-Muurolol	0.21	Sesquiterpenic alcohol
<i>trans</i> -Calamenen-10-ol	0.01	Sesquiterpenic alcohol
(3 <i>Z</i>)-Caryophylla-3,8(13)-dien-5β-ol	0.01	Sesquiterpenic alcohol
α-Bisabolol	0.01	Sesquiterpenic alcohol
meta-Camphorene	0.01	Diterpene
para-Camphorene	0.01	Diterpene
Consolidated total	99.25%	

*: Individual compounds concentration could not be found due to overlapping coelutions on columns considered [xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated total

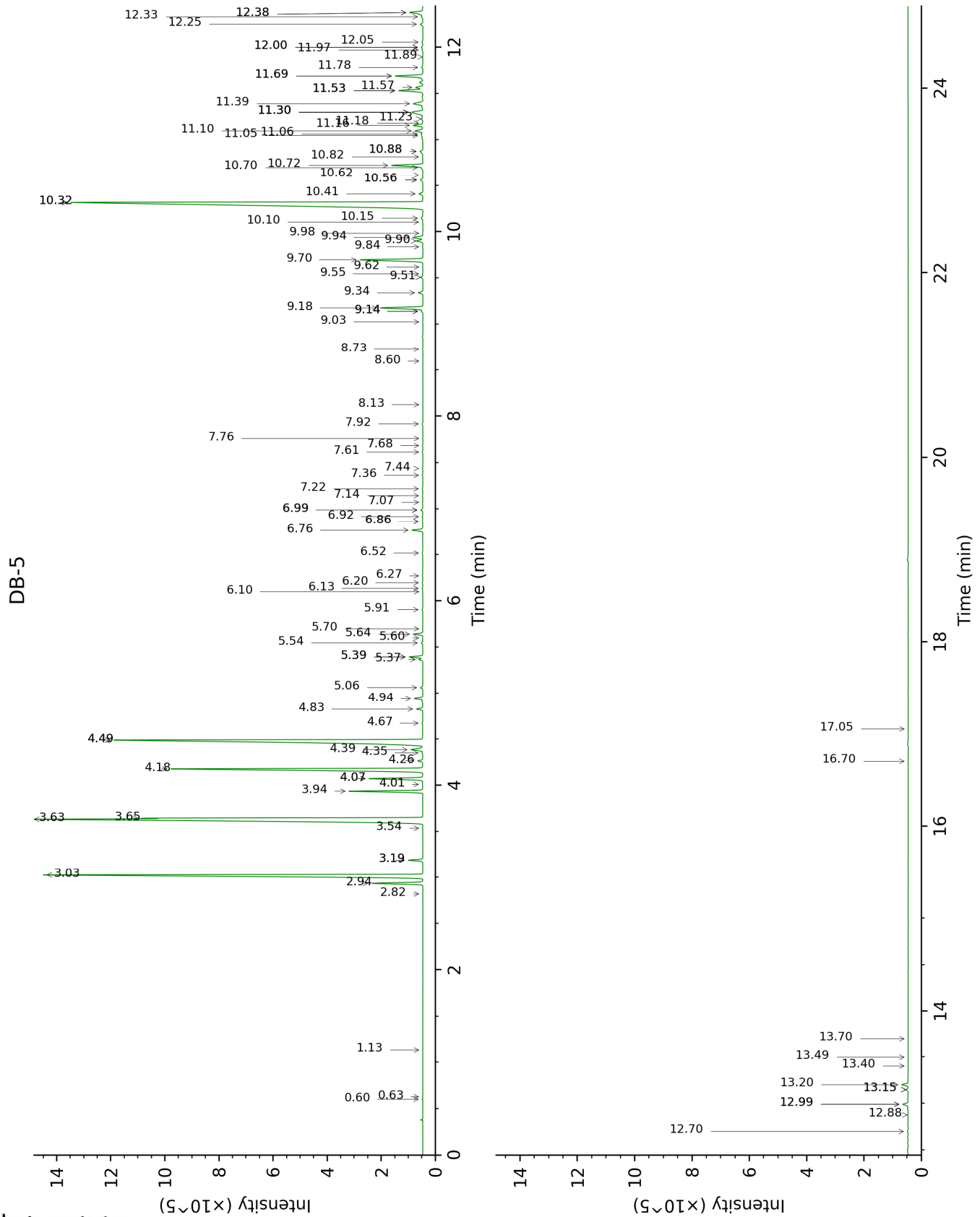
tr: The compound has been detected below 0.005% of total signal.

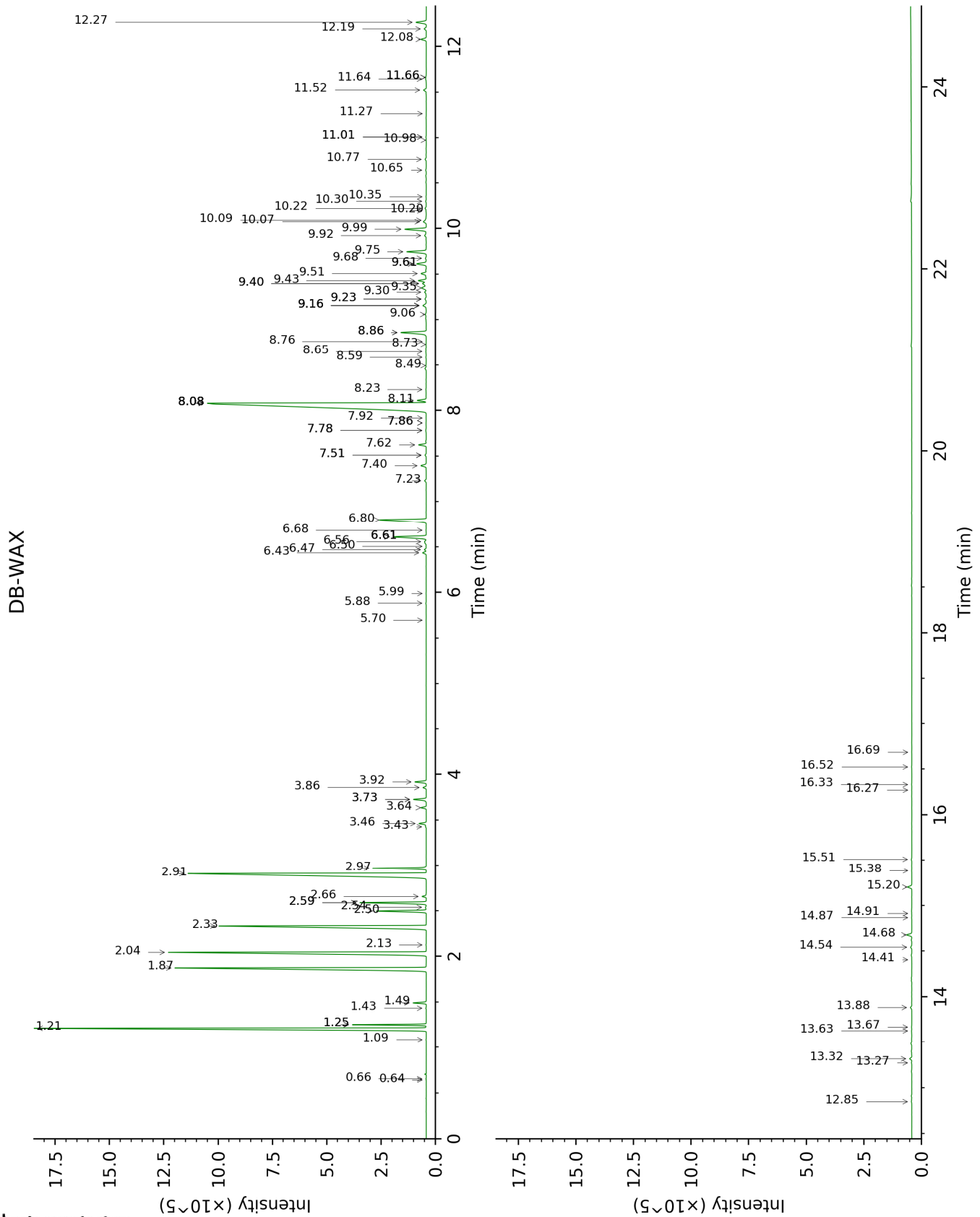
Note: no correction factor was applied

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.

This page was intentionally left blank. The following pages present the complete data of the analysis.





FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.60	642	0.01	0.66	883	0.01
2-Methylbutyral	0.63	653	tr	0.64	878	tr
Toluene	1.13	759	tr	1.25*	1002	1.47
Tricyclene	2.82	918	0.01	1.09	972	0.01
α -Thujene	2.94	926	1.46	1.25*	1002	[1.47]
α -Pinene	3.03	932	13.39	1.21	995	13.42
Camphene	3.19*	943	0.37	1.49	1027	0.35
α -Fenchene	3.19*	943	[0.37]	1.43	1021	0.01
meta-Cymene	3.54	966	0.01	2.59*	1134	2.00
β -Pinene	3.63†	973	20.98	1.87	1067	10.40
Sabinene	3.65†	973	[20.98]	2.04	1085	10.64
Myrcene	3.94	993	1.98	2.59*	1134	[2.00]
2-Carene	4.01	998	0.01	2.13	1094	0.01
α -Phellandrene	4.07*	1002	1.54	2.50	1126	1.53
Pseudolimonene	4.07*	1002	[1.54]	2.54	1129	0.04
Δ 3-Carene	4.18	1009	9.00	2.33	1113	9.00
α -Terpinene	4.26	1014	0.14	2.66	1139	0.14
ortho-Cymene	4.35	1020	0.02	3.73*	1226	0.45
para-Cymene	4.39	1022	0.42	3.73*	1226	[0.45]
Limonene	4.49*	1028	14.92	2.91	1160	13.40
β -Phellandrene	4.49*	1028	[14.92]	2.97	1165	1.59
(Z)- β -Ocimene	4.67	1040	0.02	3.43	1202	0.03
(E)- β -Ocimene	4.82	1050	0.17	3.64	1219	0.17
γ -Terpinene	4.94	1057	0.23	3.46	1205	0.26
cis-Sabinene hydrate	5.06	1065	0.07	6.47	1426	0.07
Isoterpinolene	5.37	1084	0.10	3.86	1235	0.11
para-Cymenene	5.39*	1086	0.40	5.88	1382	0.02
Terpinolene	5.39*	1086	[0.40]	3.92	1240	0.38
trans-Sabinene hydrate	5.54	1096	0.04	7.51*	1504	0.05
Unknown [m/z 109, 43 (65), 95 (54), 119 (50), 91 (47)... 149 (8)...]	5.60	1099	0.01	5.70	1369	0.01
Linalool	5.64	1102	0.27	7.62	1512	0.27
Verbenol analog?	5.70	1105	0.01	7.92	1535	0.01
trans-para-Mentha-2,8-dien-1-ol	5.90	1119	0.03	8.49	1580	0.01
cis-Limonene oxide	6.10	1131	0.01	5.99	1390	0.01
cis-para-Mentha-2,8-dien-1-ol	6.14	1134	0.02	9.06	1626	0.05
trans-para-Mentha-2-en-1-ol	6.20	1138	0.02	8.58	1588	0.02
trans-Verbenol	6.27	1142	0.02	9.16*	1634	0.18
Pinocarvone	6.52	1158	0.02	7.51*	1504	[0.05]

Terpinen-4-ol	6.76	1174	0.32	8.11	1550	0.33
Cryptone	6.86*	1181	0.02	8.73	1599	0.01
meta-Cymen-8-ol	6.86*	1181	[0.02]	11.01*	1790	0.02
para-Cymen-8-ol	6.92	1184	0.01	11.01*	1790	[0.02]
α-Terpineol	6.99*	1189	0.06	9.30	1646	0.07
Myrtenal	6.99*	1189	[0.06]	8.23	1560	0.02
Unknown [m/z 67, 41 (99), 109 (98), 43 (97), 81 (94), 91 (93)...152 (12)]	7.07	1194	0.02			
Unknown [m/z 109, 91 (100), 81 (88), 94 (75), 119 (74), 96 (73), 41 (63)... 150 (2)]	7.14	1199	0.02	10.35	1733	0.01
Verbenone	7.22	1204	0.03	9.23*	1639	0.07
Car-2-en-4-one?	7.36	1214	0.02	9.16*	1634	[0.18]
trans-Carveol	7.44	1219	0.02	10.98	1786	0.01
cis-Carveol	7.61	1231	0.02	11.27	1812	0.01
Cuminal	7.68	1236	0.01	10.20	1719	0.01
Carvone	7.76	1241	0.01	9.61*	1671	0.42
Unknown [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	7.92	1252	0.03	10.65	1758	0.03
Methyl citronellate	8.13	1266	0.01	7.78*	1525	0.03
Unknown [m/z 43, 93 (66), 91 (44), 41 (38), 69 (35)... 152? (1)]	8.60	1298	0.01			
Car-3-en-5-one	8.73	1303	0.02	11.66*	1848	0.02
Methyl geranate	9.03	1325	0.01	9.40*	1653	0.18
Bicycloelemene	9.14*	1333	0.04	6.68	1442	0.01
δ-Elemene isomer	9.14*	1333	[0.04]	6.50	1428	0.01
δ-Elemene	9.18	1335	1.35	6.61*	1436	1.34
α-Cubebene	9.34	1347	0.14	6.44	1423	0.14
Cyclosativene I	9.51	1359	0.06	6.56	1432	0.11
Cyclosativene II	9.55	1361	0.02	6.61*	1436	[1.34]
α-Ylangene	9.62	1367	0.01	6.61*	1436	[1.34]
α-Copaene	9.70	1372	2.12	6.80	1450	2.11
cis-β-Elemene	9.84	1382	0.02	7.86*	1531	0.02
β-Cubebene	9.90	1386	0.22	7.40	1495	0.22
β-Elemene	9.94	1389	0.34	8.08*	1548	22.02
Unknown [m/z 71, 100 (92), 111 (79), 69 (46), 109 (45)...]	9.98	1392	0.01	16.69	2349	0.01
Isocaryophyllene	10.10	1401	0.02	7.78*	1525	[0.03]
α-Gurjunene	10.15	1404	0.06	7.23	1483	0.07
cis-α-Bergamotene	10.32*	1417	21.77	7.86*	1531	[0.02]
β-Caryophyllene	10.32*	1417	[21.77]	8.08*	1548	[22.02]
β-Copaene	10.41	1424	0.13	8.08*	1548	[22.02]
α-Guaiene	10.56*	1435	0.09	8.08*	1548	[22.02]

<i>trans</i> - α -Bergamotene	10.56*	1435	[0.09]	8.08*	1548	[22.02]
Unknown [m/z 41, 97 (78), 69 (77), 43 (71), 125 (67), 55 (56)... 168 (39)]	10.62	1439	0.01	16.52	2331	0.01
Unknown [m/z 139, 69 (60), 41 (51), 43 (47), 119 (41)... 204 (1)]	10.70	1445	0.05			
α -Humulene	10.72	1447	1.04	8.86*	1609	1.08
allo-Aromadendrene	10.82	1454	0.02	8.65	1592	0.03
(<i>E</i>)- β -Farnesene	10.88*	1458	0.13	9.16*	1634	[0.18]
β -Santalene	10.88*	1458	[0.13]	8.76	1601	0.01
<i>trans</i> -Cadina-1(6),4-diene	11.05	1471	0.04	8.86*	1609	[1.08]
γ -Muurolene	11.06	1472	0.05	9.16*	1634	[0.18]
Germacrene D	11.10	1475	0.29	9.35	1649	0.25
β -Selinene	11.16†	1479	0.33	9.43	1656	0.32
ar-Curcumene	11.18†	1481	[0.33]	10.22	1722	0.05
<i>trans</i> -Muurola-4(15),5-diene	11.23	1485	0.05	9.40*	1653	[0.18]
α -Selinene	11.30*	1490	0.58	9.51	1662	0.22
Bicyclogermacrene	11.30*	1490	[0.58]	9.68	1676	0.03
Viridiflorene	11.30*	1490	[0.58]	9.23*	1639	[0.07]
epi-Cubebol	11.30*	1490	[0.58]	11.52	1835	0.12
α -Muurolene	11.39	1497	0.41	9.61*	1671	[0.42]
Cubebol	11.53*†	1508	1.08	12.08	1885	0.22
γ -Cadinene	11.53*†	1508	[1.08]	9.92	1696	0.08
β -Bisabolene	11.53*†	1508	[1.08]	9.75	1682	0.79
7-epi- α -Selinene	11.57†	1510	[1.08]	10.08	1709	0.13
δ -Cadinene	11.69*	1520	0.95	9.99	1702	0.87
<i>trans</i> -Calamenene	11.69*	1520	[0.95]	10.77	1768	0.05
(<i>E</i>)- γ -Bisabolene	11.78	1527	0.04	10.09	1710	0.03
α -Calacorene	11.90	1536	0.01	11.66*	1848	[0.02]
(<i>E</i>)- α -Bisabolene	11.97	1542	0.02	10.30	1728	0.03
Isocaryophyllene epoxide B	12.00*	1544	0.06	11.64	1846	0.04
α -Elemol	12.00*	1544	[0.06]	13.67	2035	0.02
Unknown [m/z 91, 41 (97), 107 (96), 93 (95), 133 (88), 69 (88), 149 (84)... 218 (19)]	12.06	1549	0.04	13.63	2031	0.02
(<i>E</i>)-Nerolidol	12.25	1564	0.09	13.32	2001	0.08
Spathulenol	12.33	1570	0.05	13.88	2056	0.06
Caryophyllene oxide	12.38*	1574	0.55	12.27	1902	0.43
Caryophyllene oxide isomer	12.38*	1574	[0.55]	12.19	1896	0.09

Humulene epoxide II	12.70	1600	0.03	12.85	1957	0.02
α -Corocalene	12.88	1614	0.02	13.27	1997	0.02
Caryophylladienol I	12.99*	1624	0.19	15.51	2222	0.02
Alismol	12.99*	1624	[0.19]	15.20	2190	0.18
τ -Muurolol	13.15*	1637	0.06	14.54	2122	0.05
τ -Cadinol	13.15*	1637	[0.06]	14.41	2108	0.01
α -Muurolol	13.20	1641	0.21	14.68	2136	0.20
<i>trans</i> -Calamennen-10-ol	13.40	1658	0.01	16.27	2303	0.01
(3 <i>Z</i>)-Caryophylla-3,8(13)-dien-5 β -ol	13.50	1666	0.01	16.33	2310	0.02
α -Bisabolol	13.70	1682	0.01	14.91	2160	0.01
meta-Camphorene	16.70	1952	0.01	14.87	2155	0.01
para-Camphorene	17.05	1985	0.01	15.38	2208	0.01
Total identified		98.97%			98.94%	
Total reported		99.17%			99.03%	

*: Two or more compounds are coeluting on this column

[xx]: Duplicate percentage due to coelutions, not taken into account in the consolidated total

†: Peaks apexes were resolved, but peaks overlapped and were summed for analysis

‡: 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