

Date : February 28, 2022

CERTIFICATE OF ANALYSIS – GC PROFILING

SAMPLE IDENTIFICATION

Internal code : 22B21-PTH03

Customer identification : Peppermint Western - USA - PF01072110R

Type : Essential oil

Source : *Mentha x piperita*

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 : Seydou Ka, Ph. D.

Analysis date : February 25, 2022

Checked and approved by :

Alexis St-Gelais, Ph. D., Chimiste 2013-174

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PHYSICOCHEMICAL DATA

Physical aspect: Clear Liquid

Refractive index: 1.4627 ± 0.0003 (20 °C; method PC-MAT-016)

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 |
|--|-------|----------------------|
| Isobutyral | tr | Aliphatic aldehyde |
| Isovaleral | 0.03 | Aliphatic aldehyde |
| 2-Methylbutyral | 0.02 | Aliphatic aldehyde |
| Isoamyl alcohol | 0.02 | Aliphatic alcohol |
| 2-Methylbutanol | 0.03 | Aliphatic alcohol |
| (3Z)-Hexenol | 0.01 | Aliphatic alcohol |
| Hexanol | 0.01 | Aliphatic alcohol |
| <i>trans</i> -2,5-Diethyltetrahydrofuran | 0.02 | Furan |
| α -Thujene | 0.05 | Monoterpene |
| α -Pinene | 0.57 | Monoterpene |
| 3-Methylcyclohexanone | 0.02 | Aliphatic ketone |
| Camphene | 0.02 | Monoterpene |
| α -Fenchene | tr | Monoterpene |
| Thuja-2,4(10)-diene | 0.01 | Monoterpene |
| β -Pinene | 0.84 | Monoterpene |
| Sabinene | 0.44 | Monoterpene |
| Octen-3-ol | 0.09 | Aliphatic alcohol |
| Octan-3-one | 0.02 | Aliphatic ketone |
| Myrcene | 0.28 | Monoterpene |
| Pseudolimonene | 0.02 | Monoterpene |
| Octan-3-ol | 0.27 | Aliphatic alcohol |
| α -Phellandrene | 0.03 | Monoterpene |
| α -Terpinene | 0.28 | Monoterpene |
| para-Cymene | 0.11 | Monoterpene |
| 1,8-Cineole | 4.58 | Monoterpenic ether |
| Limonene | 1.46 | Monoterpene |
| (Z)- β -Ocimene | 0.33 | Monoterpene |
| (E)- β -Ocimene | 0.09 | Monoterpene |
| γ -Terpinene | 0.48 | Monoterpene |
| <i>cis</i> -Sabinene hydrate | 1.06 | Monoterpenic alcohol |
| <i>cis</i> -Linalool oxide (fur.) | 0.02 | Monoterpenic alcohol |
| Octanol | 0.01 | Aliphatic alcohol |
| Terpinolene | 0.15 | Monoterpene |
| para-Cymenene | 0.01 | Monoterpene |
| <i>trans</i> -Sabinene hydrate | 0.10 | Monoterpenic alcohol |
| Linalool | 0.32 | Monoterpenic alcohol |
| 2-Methylbutyl 2-methylbutyrate | 0.07 | Aliphatic ester |
| Amyl isovalerate | 0.02 | Aliphatic ester |
| endo-Fenchol | 0.09 | Monoterpenic alcohol |
| Octen-3-yl acetate | 0.02 | Aliphatic ester |
| <i>cis</i> -para-Menth-2-en-1-ol | 0.07 | Monoterpenic alcohol |
| Octan-3-yl acetate | 0.05 | Aliphatic ester |
| Isopulegol | 0.16 | Monoterpenic alcohol |
| Menthone | 18.32 | Monoterpenic ketone |
| Isomenthone | 2.66 | Monoterpenic ketone |

| | | |
|----------------------|-------|------------------------|
| Menthofuran | 5.00 | Monoterpenic ether |
| δ-Terpineol | 0.15 | Monoterpenic alcohol |
| neo-Menthol | 3.15 | Monoterpenic alcohol |
| Terpinen-4-ol | 1.00 | Monoterpenic alcohol |
| Menthol | 40.88 | Monoterpenic alcohol |
| Isomenthol | 0.59 | Monoterpenic alcohol |
| para-Cymen-8-ol | 0.01 | Monoterpenic alcohol |
| neoiso-Menthol | 0.19 | Monoterpenic alcohol |
| Myrtenal | 0.02 | Monoterpenic aldehyde |
| α-Terpineol | 0.14 | Monoterpenic alcohol |
| Myrtenol | 0.02 | Monoterpenic alcohol |
| Methylchavicol | 0.02 | Phenylpropanoid |
| trans-Isopiperitenol | 0.01 | Monoterpenic alcohol |
| Unknown | 0.01 | Unknown |
| trans-Piperitol | 0.01 | Monoterpenic alcohol |
| Decanal | 0.02 | Aliphatic aldehyde |
| cis-Isocarveol | 0.03 | Monoterpenic alcohol |
| Citronellol | 0.02 | Monoterpenic alcohol |
| Pulegone | 1.74 | Monoterpenic ketone |
| Carvone | 0.02 | Monoterpenic ketone |
| Piperitone | 0.39 | Monoterpenic ketone |
| neo-Menthyl acetate | 0.25 | Monoterpenic ester |
| Decanol | 0.01 | Aliphatic alcohol |
| 2-Ethylmenthone? | 0.05 | Aliphatic ketone |
| Dihydroedulan I | 0.04 | Terpenic ether |
| Menthyl acetate | 4.95 | Monoterpenic ester |
| Isomenthyl acetate | 0.25 | Monoterpenic alcohol |
| Unknown | 0.02 | Unknown |
| Bicycloelemene | 0.01 | Sesquiterpene |
| Piperitenone | 0.01 | Monoterpenic ketone |
| α-Cubebene | 0.02 | Sesquiterpene |
| α-Copaene | 0.05 | Sesquiterpene |
| β-Bourbonene | 0.32 | Sesquiterpene |
| β-Elemene | 0.10 | Sesquiterpene |
| Unknown | 0.05 | Unknown |
| Unknown | tr | Sesquiterpene |
| Isocaryophyllene | 0.04 | Sesquiterpene |
| β-Caryophyllene | 2.24 | Sesquiterpene |
| β-Ylangene | 0.18 | Sesquiterpene |
| β-Copaene | 0.05 | Sesquiterpene |
| Isogermacrene D | 0.03 | Sesquiterpene |
| α-Humulene | 0.11 | Sesquiterpene |
| Muurola-4,11-diene | 0.03 | Sesquiterpene |
| (E)-β-Farnesene | 0.45 | Sesquiterpene |
| Germacrene D | 2.33 | Sesquiterpene |
| Menthylactone | 0.01 | Monoterpenic lactone |
| Viridiflorene | 0.03 | Sesquiterpene |
| Bicyclogermacrene | 0.32 | Sesquiterpene |
| α-Muurolene | 0.10 | Sesquiterpene |
| γ-Cadinene | 0.04 | Sesquiterpene |
| δ-Cadinene | 0.11 | Sesquiterpene |
| Spathulenol | 0.03 | Sesquiterpenic alcohol |

| | | |
|---------------------------|---------------|------------------------|
| Caryophyllene oxide | 0.05 | Sesquiterpenic ether |
| Viridiflorol | 0.27 | Sesquiterpenic alcohol |
| τ -Cadinol | 0.02 | Sesquiterpenic alcohol |
| Consolidated total | 99.30% | |

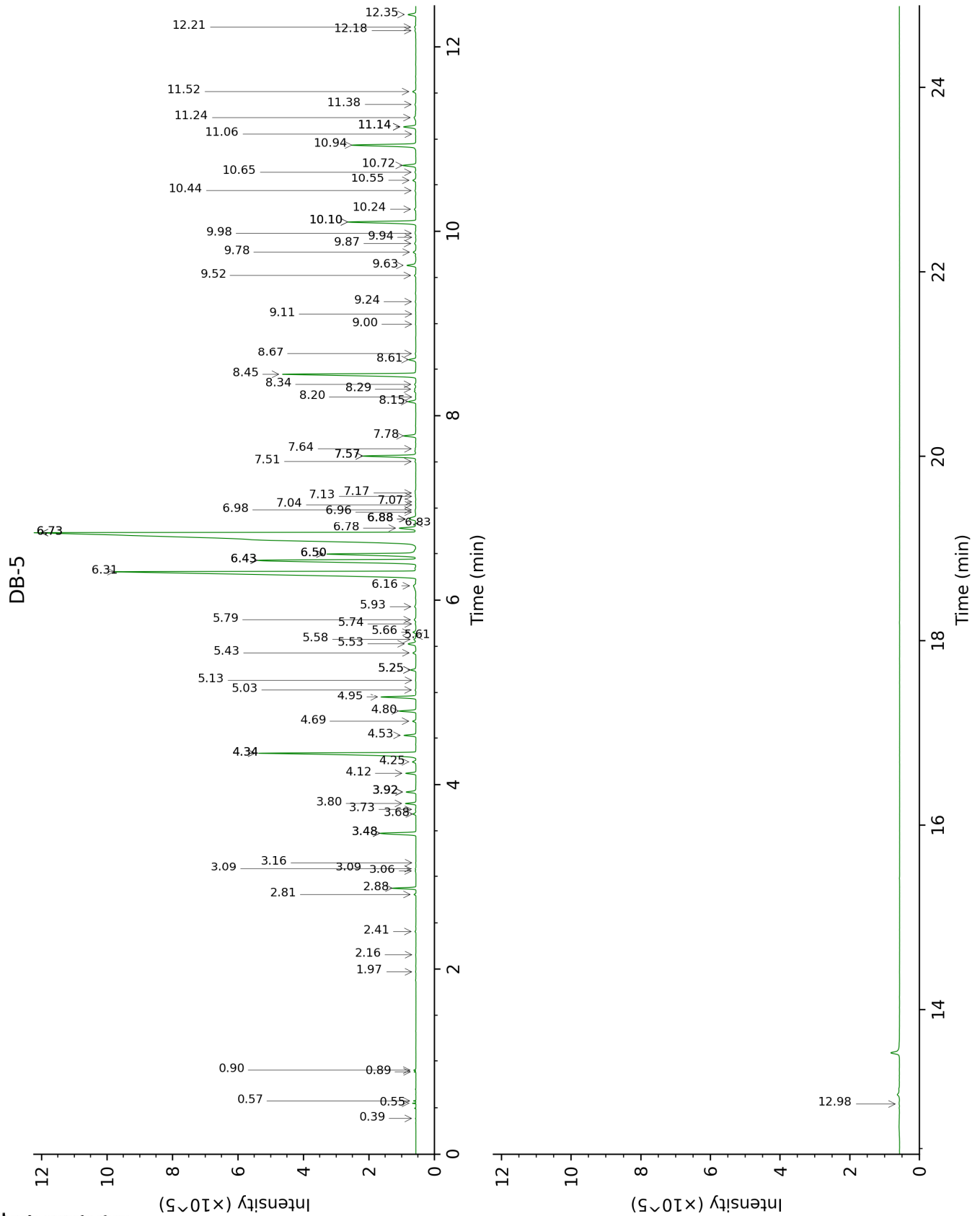
tr: The compound has been detected below 0.005% of total signal.

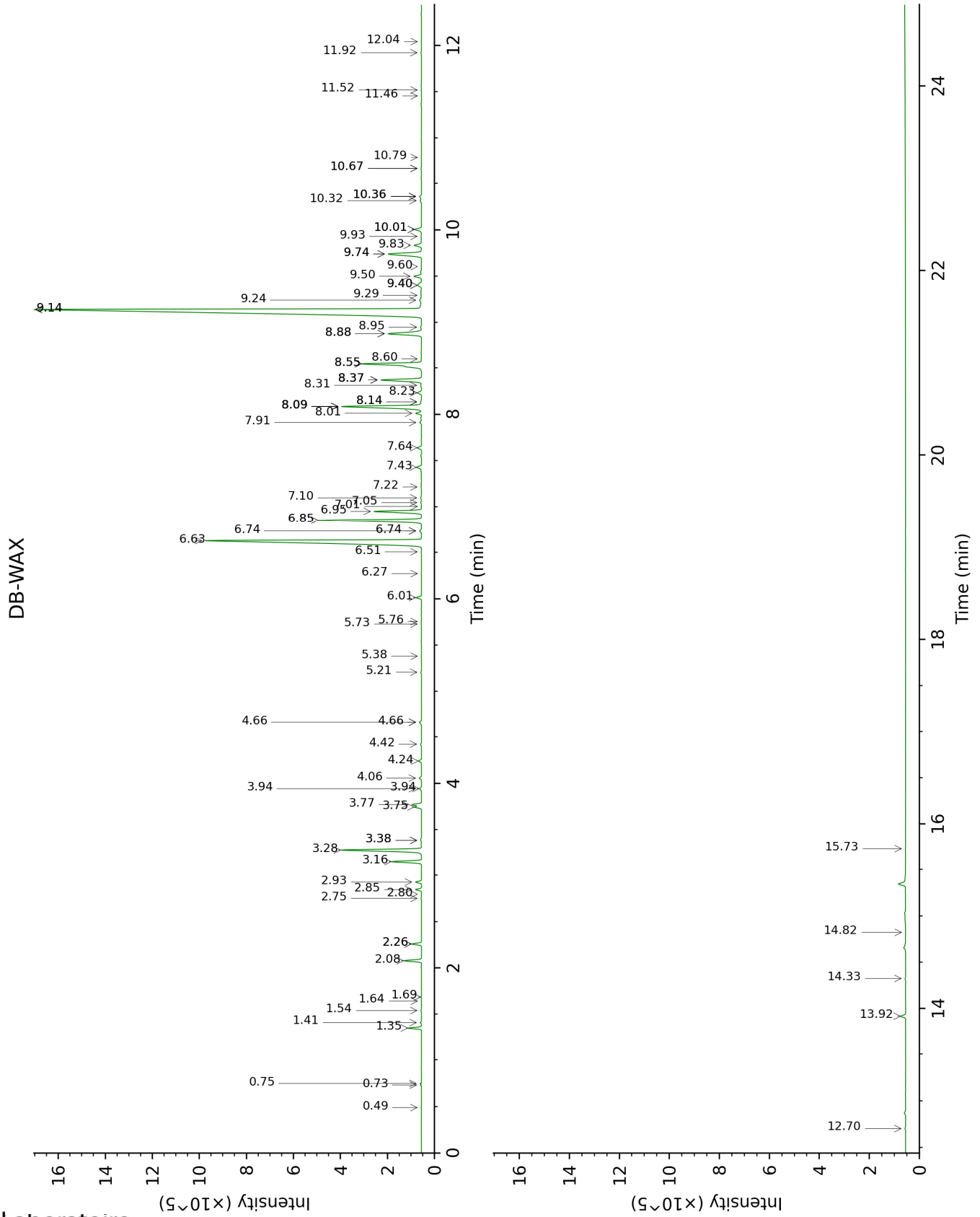
Note: no correction factor was applied

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 | % |
| Isobutyral | 0.39 | 536 | tr | 0.49 | 784 | 0.01 |
| Isovaleral | 0.55 | 640 | 0.03 | 0.75 | 888 | 0.03 |
| 2-Methylbutyral | 0.57 | 650 | 0.02 | 0.73 | 881 | 0.02 |
| Isoamyl alcohol | 0.89 | 731 | 0.02 | 3.38* | 1176 | 0.06 |
| 2-Methylbutanol | 0.90 | 734 | 0.03 | 3.38* | 1176 | [0.06] |
| (3Z)-Hexenol | 1.97 | 858 | 0.01 | 5.73 | 1349 | 0.02 |
| Hexanol | 2.16 | 874 | 0.01 | 5.38 | 1324 | 0.01 |
| <i>trans</i> -2,5-Diethyltetrahydrofuran | 2.41 | 896 | 0.02 | 1.54 | 1014 | 0.02 |
| α -Thujene | 2.81 | 925 | 0.05 | 1.41 | 1001 | 0.05 |
| α -Pinene | 2.88 | 929 | 0.57 | 1.35 | 992 | 0.57 |
| 3-Methylcyclohexanone | 3.06 | 942 | 0.02 | 4.66* | 1273 | 0.12 |
| Camphene | 3.09* | 944 | 0.02 | 1.69 | 1028 | 0.02 |
| α -Fenchene | 3.09* | 944 | [0.02] | 1.64 | 1024 | tr |
| Thuja-2,4(10)-diene | 3.16 | 948 | 0.01 | 2.26* | 1084 | 0.45 |
| β -Pinene | 3.48* | 970 | 1.30 | 2.08 | 1067 | 0.84 |
| Sabinene | 3.48* | 970 | [1.30] | 2.26* | 1084 | [0.45] |
| Octen-3-ol | 3.68 | 984 | 0.09 | 6.74* | 1422 | 0.12 |
| Octan-3-one | 3.73 | 988 | 0.02 | 3.94* | 1220 | 0.11 |
| Myrcene | 3.80 | 992 | 0.28 | 2.85 | 1134 | 0.28 |
| Pseudolimonene | 3.92* | 1000 | 0.29 | 2.80 | 1130 | 0.02 |
| Octan-3-ol | 3.92* | 1000 | [0.29] | 6.01 | 1369 | 0.27 |
| α -Phellandrene | 3.92* | 1000 | [0.29] | 2.75 | 1126 | 0.03 |
| α -Terpinene | 4.12 | 1013 | 0.28 | 2.93 | 1140 | 0.28 |
| para-Cymene | 4.25 | 1021 | 0.11 | 4.06 | 1228 | 0.11 |
| 1,8-Cineole | 4.34* | 1027 | 6.08 | 3.28 | 1168 | 4.58 |
| Limonene | 4.34* | 1027 | [6.08] | 3.16 | 1158 | 1.46 |
| (Z)- β -Ocimene | 4.53 | 1039 | 0.33 | 3.74 | 1205 | 0.33 |
| (E)- β -Ocimene | 4.69 | 1049 | 0.09 | 3.94* | 1220 | [0.11] |
| γ -Terpinene | 4.80 | 1056 | 0.48 | 3.77 | 1207 | 0.49 |
| <i>cis</i> -Sabinene hydrate | 4.95 | 1066 | 1.06 | 6.85* | 1430 | 6.05 |
| <i>cis</i> -Linalool oxide (fur.) | 5.03 | 1071 | 0.02 | 6.51 | 1405 | 0.02 |
| Octanol | 5.14 | 1077 | 0.01 | 8.14* | 1526 | 0.05 |
| Terpinolene | 5.25* | 1084 | 0.16 | 4.24 | 1242 | 0.15 |
| para-Cymenene | 5.25* | 1084 | [0.16] | 6.27 | 1388 | 0.01 |
| <i>trans</i> -Sabinene hydrate | 5.43 | 1096 | 0.10 | 7.91 | 1509 | 0.10 |
| Linalool | 5.53 | 1102 | 0.32 | 8.01 | 1517 | 0.30 |
| 2-Methylbutyl 2-methylbutyrate | 5.58 | 1105 | 0.07 | 4.42 | 1255 | 0.06 |
| Amyl isovalerate | 5.61 | 1108 | 0.02 | 4.66* | 1273 | [0.12] |
| endo-Fenchol | 5.66 | 1110 | 0.09 | 8.37* | 1545 | 2.44 |
| Octen-3-yl acetate | 5.74 | 1116 | 0.02 | 5.76 | 1351 | 0.01 |
| <i>cis</i> -para-Menth-2-en-1-ol | 5.79 | 1119 | 0.07 | 8.09* | 1523 | 5.12 |
| Octan-3-yl acetate | 5.93 | 1128 | 0.05 | 5.21 | 1311 | 0.04 |
| Isopulegol | 6.16 | 1142 | 0.16 | 8.09* | 1523 | [5.12] |

| | | | | | | |
|---|--------|------|---------|--------|------|--------|
| Menthone | 6.31 | 1152 | 18.32 | 6.63 | 1414 | 18.18 |
| Isomenthone | 6.43* | 1160 | 7.66 | 6.95 | 1438 | 2.66 |
| Menthofuran | 6.43* | 1160 | [7.66] | 6.85* | 1430 | [6.05] |
| δ-Terpineol | 6.50* | 1165 | 3.45 | 9.40* | 1626 | 0.34 |
| neo-Menthol | 6.50* | 1165 | [3.45] | 8.55* | 1558 | 4.15 |
| Terpinen-4-ol | 6.73* | 1179 | 41.88 | 8.55* | 1558 | [4.15] |
| Menthol | 6.73* | 1179 | [41.88] | 9.14* | 1605 | 40.91 |
| Isomenthol | 6.78 | 1183 | 0.59 | 8.88* | 1584 | 2.34 |
| para-Cymen-8-ol | 6.83 | 1186 | 0.01 | 11.46 | 1797 | 0.01 |
| neoiso-Menthol | 6.88* | 1189 | 0.35 | 9.40* | 1626 | [0.34] |
| Myrtenal | 6.88* | 1189 | [0.35] | 8.60 | 1562 | 0.02 |
| α-Terpineol | 6.88* | 1189 | [0.35] | 9.74* | 1653 | 2.47 |
| Myrtenol | 6.96 | 1194 | 0.02 | 10.79 | 1740 | 0.01 |
| Methylchavicol | 6.98 | 1196 | 0.02 | 9.29 | 1617 | 0.03 |
| trans-Isopiperitenol | 7.04 | 1199 | 0.01 | 10.36* | 1704 | 0.12 |
| Unknown [m/z 43, 99 (84), 81 (46), 986 (43), 126 (36), 71 (28)... 170 (12)] | 7.07 | 1201 | 0.01 | | | |
| trans-Piperitol | 7.13 | 1205 | 0.01 | 10.36* | 1704 | [0.12] |
| Decanal | 7.17 | 1208 | 0.02 | 7.22 | 1457 | 0.03 |
| cis-Isocarveol | 7.51 | 1230 | 0.03 | 11.92 | 1838 | 0.05 |
| Citronellol | 7.57* | 1234 | 1.76 | 10.67* | 1730 | 0.03 |
| Pulegone | 7.57* | 1234 | [1.76] | 8.88* | 1584 | [2.34] |
| Carvone | 7.64 | 1240 | 0.02 | 9.93 | 1669 | 0.03 |
| Piperitone | 7.78 | 1249 | 0.39 | 9.83 | 1661 | 0.43 |
| neo-Menthyl acetate | 8.15 | 1274 | 0.25 | 7.64 | 1489 | 0.23 |
| Decanol | 8.20 | 1277 | 0.01 | 10.67* | 1730 | [0.03] |
| 2-Ethylmenthone? | 8.29 | 1283 | 0.05 | | | |
| Dihydroedulan I | 8.34 | 1286 | 0.04 | 7.05 | 1445 | 0.05 |
| Menthyl acetate | 8.45 | 1294 | 4.95 | 8.09* | 1523 | [5.12] |
| Isomenthyl acetate | 8.61 | 1304 | 0.25 | 8.23 | 1534 | 0.25 |
| Unknown [m/z 43, 136 (55), 121 (55), 107 (48), 93 (48), 81 (30), 79 (29)...] | 8.67 | 1309 | 0.02 | | | |
| Bicycloelemene | 9.00 | 1332 | 0.01 | 7.01 | 1442 | 0.02 |
| Piperitenone | 9.11 | 1340 | 0.01 | 12.04 | 1849 | 0.02 |
| α-Cubebene | 9.24 | 1349 | 0.02 | 6.74* | 1422 | [0.12] |
| α-Copaene | 9.52 | 1369 | 0.05 | 7.10 | 1448 | 0.06 |
| β-Bourbonene | 9.63 | 1377 | 0.32 | 7.43 | 1473 | 0.29 |
| β-Elemene | 9.78 | 1387 | 0.10 | 8.37* | 1545 | [2.44] |
| Unknown [m/z 107, 121 (79), 119 (66), 91 (58), 136 (55), 105 (49)... 194 (1)] | 9.87 | 1394 | 0.05 | | | |
| Unknown [m/z 106, 119 (99), 43 (78), 91 (74), 105 (60), 134 (55)... 204 (19)] | 9.94 | 1398 | tr | 11.52 | 1802 | 0.02 |
| Isocaryophyllene | 9.98 | 1401 | 0.04 | 8.14* | 1526 | [0.05] |
| β-Caryophyllene | 10.10* | 1410 | 2.43 | 8.37* | 1545 | [2.44] |

| | | | | | | |
|-------------------------|--------|---------------|--------|--------|---------------|---------|
| β-Ylangene | 10.10* | 1410 | [2.43] | 8.09* | 1523 | [5.12] |
| β-Copaene | 10.24 | 1421 | 0.05 | 8.31 | 1540 | 0.06 |
| Isogermacrene D | 10.44 | 1436 | 0.03 | 8.95 | 1590 | 0.05 |
| α-Humulene | 10.55 | 1444 | 0.11 | 9.24 | 1613 | 0.15 |
| Muuro-la-4,11-diene | 10.65 | 1451 | 0.03 | 9.14* | 1605 | [40.91] |
| (E)-β-Farnesene | 10.72 | 1456 | 0.45 | 9.50 | 1634 | 0.43 |
| Germacrene D | 10.94 | 1473 | 2.33 | 9.74* | 1653 | [2.47] |
| Menthylactone | 11.06 | 1482 | 0.01 | 15.74 | 2203 | 0.02 |
| Viridiflorene | 11.14* | 1488 | 0.44 | 9.60 | 1642 | 0.03 |
| Bicyclogermacrene | 11.14* | 1488 | [0.44] | 10.01* | 1675 | 0.42 |
| α-Muuro-lene | 11.24 | 1495 | 0.10 | 10.01* | 1675 | [0.42] |
| γ-Cadinene | 11.38 | 1506 | 0.04 | 10.32 | 1700 | 0.10 |
| δ-Cadinene | 11.52 | 1517 | 0.11 | 10.36* | 1704 | [0.12] |
| Spathulenol | 12.18 | 1568 | 0.03 | 14.33 | 2062 | 0.03 |
| Caryophyllene oxide | 12.21 | 1572 | 0.05 | 12.70 | 1908 | 0.03 |
| Viridiflorol | 12.35 | 1582 | 0.27 | 13.92 | 2022 | 0.27 |
| τ-Cadinol | 12.98 | 1633 | 0.02 | 14.82 | 2111 | 0.01 |
| Total identified | | 99.49% | | | 99.01% | |
| Total reported | | 99.57% | | | 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

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