## CERTIFICATE OF ANALYSIS – GC PROFILING

### SAMPLE IDENTIFICATION

**Internal code :** 19L18-PTH10
**Customer identification :** Bergamot (Bergapten Free) - Italy - B3010893R
**Type :** Essential oil
**Source :** *Citrus bergamia*
**Customer :** Plant Therapy

### ANALYSIS

**Method:** PC-MAT-007 - Analysis of the composition of an essential oil or other volatile liquide by FAST GC-FID (in French); identifications validated by GC-MS.
**Analyst :** Sylvain Mercier, M. Sc., Chimiste
**Analysis date :** December 18, 2019


Checked and approved by :

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


*Notes: This report may not be published, including online, without the written consent from Laboratoire PhytoChemia.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.*

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Clear liquid
**Refractive index:** 1.4630 ± 0.0003 (20 °C)

*NF T 75-215:2009 - OIL OF BERGAMOT - ITALY*

| Compound | Min. % | Max. % | Observed % | Complies? |
|---|---|---|---|---|
| β-Bisabolene | 0.3 | 0.6 | 0.1 | No |
| Geranial | 0.25 | 0.50 | 0.27 | Yes |
| Linalyl acetate | 22 | 36 | 30 | Yes |
| Linalool | 3 | 15 | 14 | Yes |
| γ-Terpinene | 6 | 10 | 6 | Yes |
| Limonene | 30 | 45 | 37 | Yes |
| β-Pinene | 5.5 | 9.5 | 6.6 | Yes |
| **Refractive index** | 1.4650 | 1.4700 | 1.4630 | No |

*CONCLUSION*

No adulterant, contaminant or diluent has been detected using this method. The oil marginally does not comply with the AFNOR standard for Italian bergamot oil, which is expected for bergapten free oils.

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## ANALYSIS SUMMARY – CONSOLIDATED CONTENTS

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

| Identification | % | Classe |
|---|---|---|
| α-Thujene | 0.14 | Monoterpene |
| α-Pinene | 1.03 | Monoterpene |
| Camphene | 0.03 | Monoterpene |
| β-Pinene | 6.58 | Monoterpene |
| Sabinene | 1.02 | Monoterpene |
| 6-Methyl-5-hepten-2-one | 0.01 | Aliphatic ketone |
| Myrcene | 0.81 | Monoterpene |
| α-Phellandrene | 0.02 | Monoterpene |
| Pseudolimonene | 0.01 | Monoterpene |
| Octanal | 0.04 | Aliphatic aldehyde |
| Δ3-Carene | 0.02 | Monoterpene |
| α-Terpinene | 0.06 | Monoterpene |
| para-Cymene | 0.58 | Monoterpene |
| Limonene | 36.69 | Monoterpene |
| 1,8-Cineole | 0.17 | Monoterpenic ether |
| (*Z*)-β-Ocimene | 0.03 | Monoterpene |
| (*E*)-β-Ocimene | 0.07 | Monoterpene |
| γ-Terpinene | 5.71 | Monoterpene |
| *cis*-Sabinene hydrate | 0.02 | Monoterpenic alcohol |
| *cis*-Linalool oxide (fur.) | 0.02 | Monoterpenic alcohol |
| Octanol | 0.01 | Aliphatic alcohol |
| Terpinolene | 0.13 | Monoterpene |
| *trans*-Linalool oxide (fur.) | 0.03 | Monoterpenic alcohol |
| *trans*-Sabinene hydrate | 0.01 | Monoterpenic alcohol |
| Linalool | 14.34 | Monoterpenic alcohol |
| Nonanal | 0.03 | Aliphatic aldehyde |
| *trans*-para-Mentha-2,8-dien-1-ol | tr | Monoterpenic alcohol |
| *cis*-Limonene oxide | 0.02 | Monoterpenic ether |
| *trans*-Limonene oxide | 0.01 | Monoterpenic ether |
| Camphor | 0.02 | Monoterpenic ketone |
| Epoxyterpinolene | 0.01 | Monoterpenic ether |
| Citronellal | 0.03 | Monoterpenic aldehyde |
| Terpinen-4-ol | 0.02 | Monoterpenic alcohol |
| α-Terpineol | 0.06 | Monoterpenic alcohol |
| γ-Terpineol | 0.01 | Monoterpenic alcohol |
| Unknown | tr | Unknown |
| Decanal | 0.01 | Aliphatic aldehyde |
| Octyl acetate | 0.10 | Aliphatic ester |
| Nerol | 0.01 | Monoterpenic alcohol |
| Citronellol | 0.01 | Monoterpenic alcohol |
| Neral | 0.22 | Monoterpenic aldehyde |
| (*cis*?)-Linalool oxide acetate (fur.)? | 0.06 | Monoterpenic ester |
| Geraniol | 0.04 | Monoterpenic alcohol |
| Linalyl acetate | 30.16 | Monoterpenic ester |
| Geranial | 0.27 | Monoterpenic aldehyde |
| (*trans*?)-Linalool oxide acetate (fur.)? | 0.14 | Monoterpenic ester |
| Unknown | 0.02 | Unknown |

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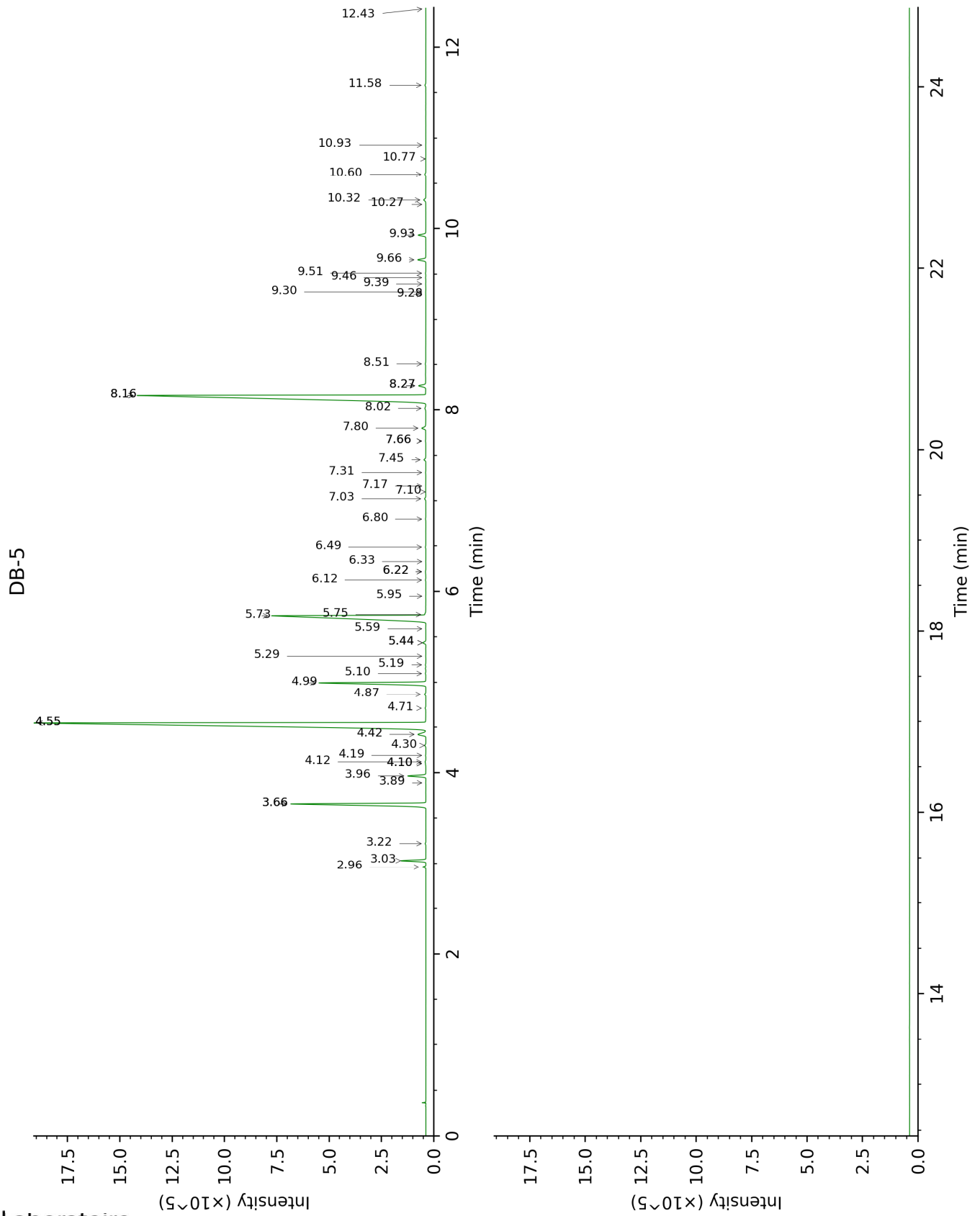| | | |
|---|---|---|
| Linalyl propionate | 0.01 | Monoterpenic ester |
| Hodiendiol derivative | 0.01 | Oxygenated monoterpene |
| α-Terpinyl acetate | 0.01 | Monoterpenic ester |
| Unknown | 0.01 | Monoterpenic ester |
| Unknown | 0.02 | Oxygenated monoterpene |
| Neryl acetate | 0.43 | Monoterpenic ester |
| Geranyl acetate | 0.41 | Monoterpenic ester |
| Dodecanal | 0.01 | Aliphatic aldehyde |
| β-Caryophyllene | 0.13 | Sesquiterpene |
| *trans*-α-Bergamotene | 0.06 | Sesquiterpene |
| α-Humulene | 0.01 | Sesquiterpene |
| (*E*)-β-Farnesene | 0.01 | Sesquiterpene |
| β-Bisabolene | 0.05 | Sesquiterpene |
| Caryophyllene oxide | 0.01 | Sesquiterpenic ether |
| **Consolidated total** | **100.02%** | |

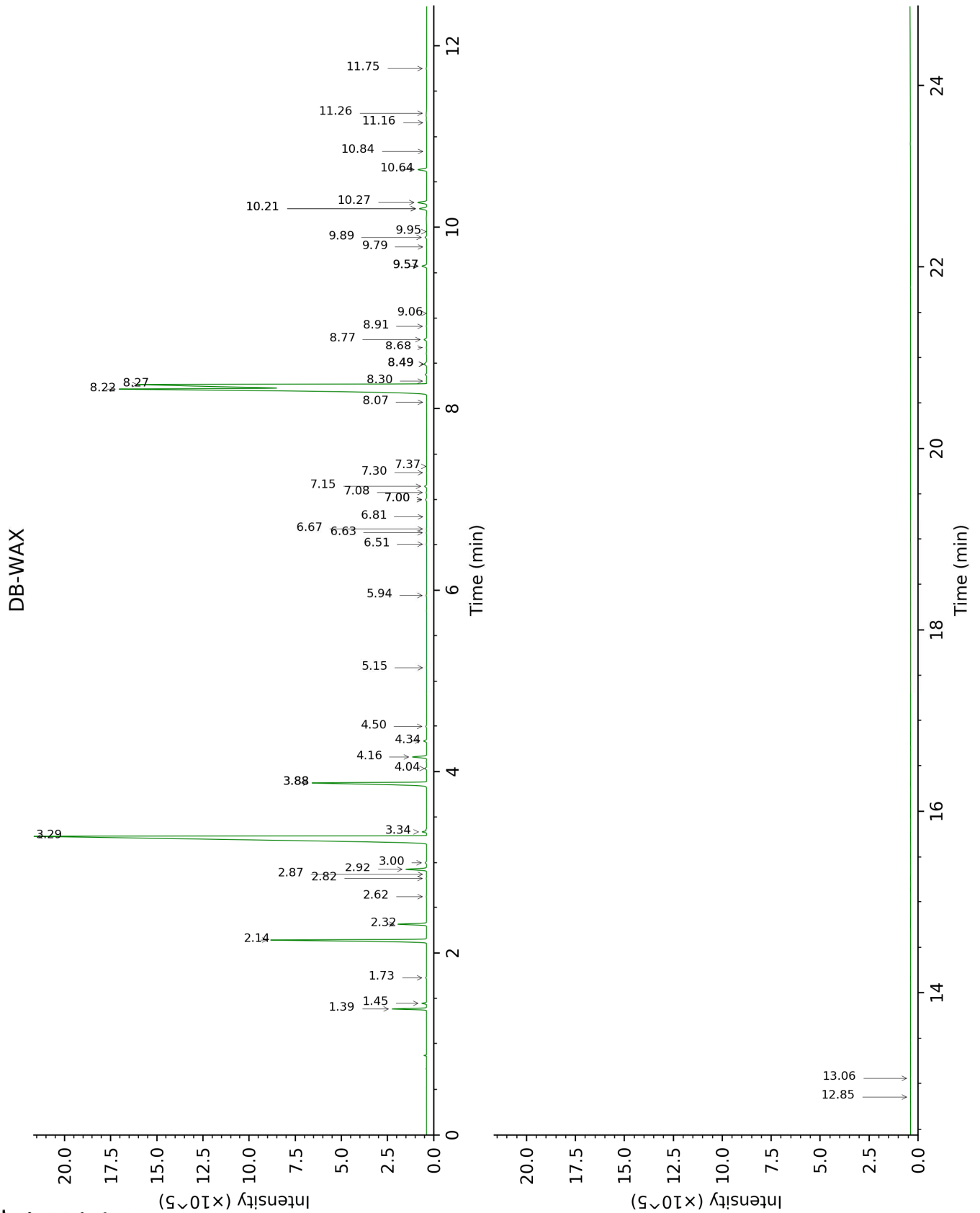tr: The compound has been detected below 0.005% of total signal.

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.

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DB-5



**Top chromatogram (0–12 min):**

Peak labels (retention times): 2.96, 3.03, 3.22, 3.66, 3.89, 3.96, 4.10, 4.12, 4.19, 4.30, 4.42, 4.55, 4.71, 4.87, 4.99, 5.10, 5.19, 5.29, 5.44, 5.59, 5.73, 5.75, 5.95, 6.12, 6.22, 6.33, 6.49, 6.80, 7.03, 7.10, 7.17, 7.31, 7.45, 7.66, 7.80, 8.02, 8.16, 8.27, 8.51, 9.28, 9.30, 9.39, 9.46, 9.51, 9.66, 9.93, 10.27, 10.32, 10.60, 10.77, 10.93, 11.58, 12.43

Time (min)

Intensity (×10^5)

**Bottom chromatogram (14–24 min):**

Time (min)

Intensity (×10^5)

DB-WAX

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*FULL ANALYSIS DATA*

| Identification | Column DB-5 | | | Column DB-WAX | | |
|---|---|---|---|---|---|---|
| | R.T | R.I | % | R.T | R.I | % |
| α-Thujene | 2.96 | 924 | 0.14 | 1.45 | 997 | 0.13 |
| α-Pinene | 3.03 | 929 | 1.03 | 1.39 | 990 | 1.03 |
| Camphene | 3.22 | 941 | 0.03 | 1.73 | 1025 | 0.03 |
| β-Pinene | 3.66* | 970 | 7.56 | 2.14 | 1066 | 6.58 |
| Sabinene | 3.66* | 970 | [7.56] | 2.32 | 1084 | 1.02 |
| 6-Methyl-5-hepten-2-one | 3.89 | 986 | 0.01 | 5.15 | 1297 | 0.01 |
| Myrcene | 3.96 | 991 | 0.81 | 2.92 | 1133 | 0.82 |
| α-Phellandrene | 4.10* | 1000 | 0.02 | 2.82 | 1125 | 0.02 |
| Pseudolimonene | 4.10* | 1000 | [0.02] | 2.87 | 1128 | 0.01 |
| Octanal | 4.12 | 1001 | 0.04 | 4.50 | 1251 | 0.04 |
| Δ3-Carene | 4.19 | 1006 | 0.02 | 2.62 | 1109 | 0.01 |
| α-Terpinene | 4.30 | 1012 | 0.06 | 3.00 | 1139 | 0.06 |
| para-Cymene | 4.42 | 1020 | 0.58 | 4.16 | 1227 | 0.59 |
| Limonene | 4.55* | 1028 | 36.69 | 3.29 | 1162 | 36.69 |
| 1,8-Cineole | 4.55* | 1028 | [36.69] | 3.34 | 1165 | 0.17 |
| (*Z*)-β-Ocimene | 4.71 | 1038 | 0.03 | 3.88* | 1206 | 5.75 |
| (*E*)-β-Ocimene | 4.87 | 1048 | 0.07 | 4.04 | 1218 | 0.08 |
| γ-Terpinene | 4.99 | 1057 | 5.71 | 3.88* | 1206 | [5.75] |
| *cis*-Sabinene hydrate | 5.10 | 1063 | 0.02 | 7.00* | 1432 | 0.06 |
| *cis*-Linalool oxide (fur.) | 5.19 | 1069 | 0.02 | 6.63 | 1404 | 0.02 |
| Octanol | 5.29 | 1076 | 0.01 | 8.30 | 1529 | 0.03 |
| Terpinolene | 5.44* | 1085 | 0.16 | 4.34 | 1240 | 0.13 |
| *trans*-Linalool oxide (fur.) | 5.44* | 1085 | [0.16] | 7.00* | 1432 | [0.06] |
| *trans*-Sabinene hydrate | 5.59 | 1095 | 0.01 | 8.07 | 1511 | 0.01 |
| Linalool | 5.73† | 1104 | 14.37 | 8.22† | 1522 | 43.99 |
| Nonanal | 5.74† | 1105 | [14.37] | 5.94 | 1354 | 0.03 |
| *trans*-para-Mentha-2,8-dien-1-ol | 5.95 | 1118 | tr | 9.06 | 1587 | tr |
| *cis*-Limonene oxide | 6.12 | 1130 | 0.02 | 6.51 | 1395 | 0.02 |
| *trans*-Limonene oxide | 6.22* | 1136 | 0.03 | 6.67 | 1407 | 0.01 |
| Camphor | 6.22* | 1136 | [0.03] | 7.30 | 1453 | 0.02 |
| Epoxyterpinolene | 6.33 | 1143 | 0.01 | 6.81 | 1418 | 0.01 |
| Citronellal | 6.49 | 1154 | 0.03 | 7.08 | 1437 | 0.03 |
| Terpinen-4-ol | 6.80 | 1175 | 0.02 | 8.68 | 1558 | 0.04 |
| α-Terpineol | 7.02 | 1190 | 0.06 | 9.89 | 1654 | 0.07 |
| γ-Terpineol | 7.10 | 1195 | 0.01 | 9.95 | 1659 | tr |
| Unknown [m/z 43, 71 (80), 67 (55), 59 (51), 68 (44), 41 (43)...] | 7.17 | 1199 | tr | | | |

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| | | | | | | |
|---|---|---|---|---|---|---|
| Decanal | 7.31 | 1209 | 0.01 | 7.37 | 1458 | 0.01 |
| Octyl acetate | 7.45 | 1219 | 0.10 | 7.15 | 1442 | 0.10 |
| Nerol | 7.66* | 1234 | 0.02 | 11.16 | 1759 | 0.01 |
| Citronellol | 7.66* | 1234 | [0.02] | 10.84 | 1733 | 0.01 |
| Neral | 7.80 | 1240 | 0.22 | 9.57* | 1629 | 0.23 |
| (*cis*?)-Linalool oxide acetate (fur.)? | 8.02 | 1254 | 0.06 | | | |
| Geraniol | 8.16* | 1263 | 30.20 | 11.75 | 1810 | 0.04 |
| Linalyl acetate | 8.16* | 1263 | [30.20] | 8.27† | 1526 | [43.99] |
| Geranial | 8.27* | 1270 | 0.41 | 10.20* | 1680 | 0.34 |
| (*trans*?)-Linalool oxide acetate (fur.)? | 8.27* | 1270 | [0.41] | 8.77 | 1565 | 0.14 |
| Unknown [m/z 43, 121 (74), 93 (42), 95 (38), 107 (29), 41 (29), 136 (28)...] | 8.51 | 1286 | 0.02 | | | |
| Linalyl propionate | 9.28 | 1339 | 0.01 | 8.91 | 1576 | 0.02 |
| Hodiendiol derivative | 9.30 | 1341 | 0.01 | 13.06 | 1926 | 0.01 |
| α-Terpinyl acetate | 9.39 | 1347 | 0.01 | 9.78 | 1646 | 0.01 |
| Unknown [m/z 43, 121 (52), 93 (48), 79 (33), 41 (30), 136 (26), 81 (25)...] | 9.46 | 1352 | 0.01 | | | |
| Unknown [m/z 43, 79 (46), 71 (30), 94 (25), 41 (23), 81 (21)... 197 (0)] | 9.51 | 1356 | 0.02 | 11.26 | 1768 | 0.04 |
| Neryl acetate | 9.66 | 1366 | 0.43 | 10.27 | 1685 | 0.43 |
| Geranyl acetate | 9.93 | 1385 | 0.41 | 10.64 | 1716 | 0.41 |
| Dodecanal | 10.27 | 1409 | 0.01 | | | |
| β-Caryophyllene | 10.32 | 1412 | 0.13 | 8.49* | 1544 | 0.17 |
| *trans*-α-Bergamotene | 10.60 | 1434 | 0.06 | 8.49* | 1544 | [0.17] |
| α-Humulene | 10.77 | 1446 | 0.01 | | | |
| (*E*)-β-Farnesene | 10.93 | 1458 | 0.01 | 9.57* | 1629 | [0.23] |
| β-Bisabolene | 11.58 | 1506 | 0.05 | 10.20* | 1680 | [0.34] |
| Caryophyllene oxide | 12.43 | 1572 | 0.01 | 12.85 | 1907 | 0.01 |
| **Total identified** | | **99.76%** | | | **99.43%** | |
| **Total reported** | | **99.82%** | | | **99.47%** | |

*: 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

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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

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