**Date :** June 14, 2023

# *CERTIFICATE OF ANALYSIS – GC PROFILING*

## *SAMPLE IDENTIFICATION*

**Internal code :** 23F12-NPA03
**Customer identification :** Citrus bergamia - Italy - NPS00075 - Lot # NP0023
**Type :** Essential oil
**Source :** *Citrus bergamia*
**Customer :** Nature Packaged

## *ANALYSIS*

**Method:** PC-MAT-014 ISO - Analysis of the composition of an essential oil or other volatile liquid by FAST GC-FID (in French); identifications validated by GC-MS.
**Analyst :** Amélie Simard, Analyste
**Analysis date :** June 13, 2023

Checked and approved by :

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

*Notes: 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.*

*This report is an update from the first version issued on June 14, 2023, to format it for online publication.*



MÉTHODE CERTIFIÉE ISO 17025:2017 CERTIFIED METHOD

Laboratoire PhytoChemia

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## *PHYSICOCHEMICAL DATA*

**Physical aspect:** Bright yellow liquid
**Refractive index:** 1.4649 ± 0.0003 (20 °C; method PC-MAT-016)

## *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 |
|---|---|---|
| Toluene | tr | Simple phenolic |
| Tricyclene | 0.01 | Monoterpene |
| α-Thujene | 0.24 | Monoterpene |
| α-Pinene | 1.12 | Monoterpene |
| Camphene | 0.04 | Monoterpene |
| Sabinene | 1.03 | Monoterpene |
| β-Pinene | 6.57 | Monoterpene |
| 6-Methyl-5-hepten-2-one | 0.01 | Aliphatic ketone |
| Myrcene | 0.94 | Monoterpene |
| α-Phellandrene | 0.03 | Monoterpene |
| Octanal | 0.02 | Aliphatic aldehyde |
| Δ3-Carene | 0.01 | Monoterpene |
| α-Terpinene | 0.11 | Monoterpene |
| para-Cymene | 0.32 | Monoterpene |
| Limonene | 39.65 | Monoterpene |
| 1,8-Cineole | 0.19 | Monoterpenic ether |
| (*Z*)-β-Ocimene | 0.05 | Monoterpene |
| (*E*)-β-Ocimene | 0.11 | Monoterpene |
| γ-Terpinene | 6.41 | Monoterpene |
| *cis*-Sabinene hydrate | 0.02 | Monoterpenic alcohol |
| para-Mentha-3,8-diene | 0.01 | Monoterpene |
| *cis*-Linalool oxide (fur.) | 0.03 | Monoterpenic alcohol |
| Terpinolene | 0.22 | Monoterpene |
| *trans*-Linalool oxide (fur.) | 0.04 | Monoterpenic alcohol |
| Linalool | 14.47 | Monoterpenic alcohol |
| Nonanal | 0.01 | Aliphatic aldehyde |
| *trans*-para-Mentha-2,8-dien-1-ol | 0.01 | Monoterpenic alcohol |
| *cis*-Limonene oxide | 0.02 | Monoterpenic ether |
| *trans*-Limonene oxide | 0.01 | Monoterpenic ether |
| Camphor | 0.01 | Monoterpenic ketone |
| Epoxyterpinolene | 0.01 | Monoterpenic ether |
| Citronellal | 0.01 | Monoterpenic aldehyde |
| Borneol | 0.01 | Monoterpenic alcohol |
| Terpinen-4-ol | 0.01 | Monoterpenic alcohol |
| α-Terpineol | 0.02 | Monoterpenic alcohol |
| Decanal | 0.02 | Aliphatic aldehyde |
| Octyl acetate | 0.02 | Aliphatic ester |
| Nerol | 0.01 | Monoterpenic alcohol |
| Citronellol | 0.01 | Monoterpenic alcohol |
| Neral | 0.14 | Monoterpenic aldehyde |
| (*cis*?)-Linalool oxide acetate (fur.)? | 0.07 | Monoterpenic ester |
| Linalyl acetate | 25.23 | Monoterpenic ester |
| Geraniol | 0.02 | Monoterpenic alcohol |
| (*trans*?)-Linalool oxide acetate (fur.)? | 0.05 | Monoterpenic ester |
| Geranial | 0.23 | Monoterpenic aldehyde |



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| | | |
|---|---|---|
| Bornyl acetate | 0.01 | Monoterpenic ester |
| para-Mentha-1,8-diene-4-hydroperoxide | 0.01 | Monoterpenic peroxide |
| Linalyl propionate | 0.01 | Monoterpenic ester |
| Hodiendiol derivative | 0.01 | Oxygenated monoterpene |
| α-Terpinyl acetate | 0.03 | Monoterpenic ester |
| Unknown | 0.01 | Monoterpenic ester |
| Unknown | 0.02 | Oxygenated monoterpene |
| Neryl acetate | 0.43 | Monoterpenic ester |
| Geranyl acetate | 0.41 | Monoterpenic ester |
| β-Elemene | 0.01 | Sesquiterpene |
| β-Caryophyllene | 0.16 | Sesquiterpene |
| *trans*-α-Bergamotene | 0.21 | Sesquiterpene |
| α-Humulene | 0.02 | Sesquiterpene |
| (*E*)-β-Farnesene | 0.03 | Sesquiterpene |
| Germacrene D | 0.01 | Sesquiterpene |
| (*Z*)-α-Bisabolene | 0.02 | Sesquiterpene |
| Hodiendiol derivative II | 0.01 | Oxygenated monoterpene |
| β-Bisabolene | 0.50 | Sesquiterpene |
| Spathulenol | 0.01 | Sesquiterpenic alcohol |
| Caryophyllene oxide | 0.01 | Sesquiterpenic ether |
| α-Bisabolol | 0.01 | Sesquiterpenic alcohol |
| Nootkatone | 0.02 | Sesquiterpenic ketone |
| Citropten | 0.02 | Furanocoumarin |
| para-Camphorene | 0.01 | Diterpene |
| Bergapten | 0.01 | Furanocoumarin |
| **Consolidated total** | **99.59%** | |

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

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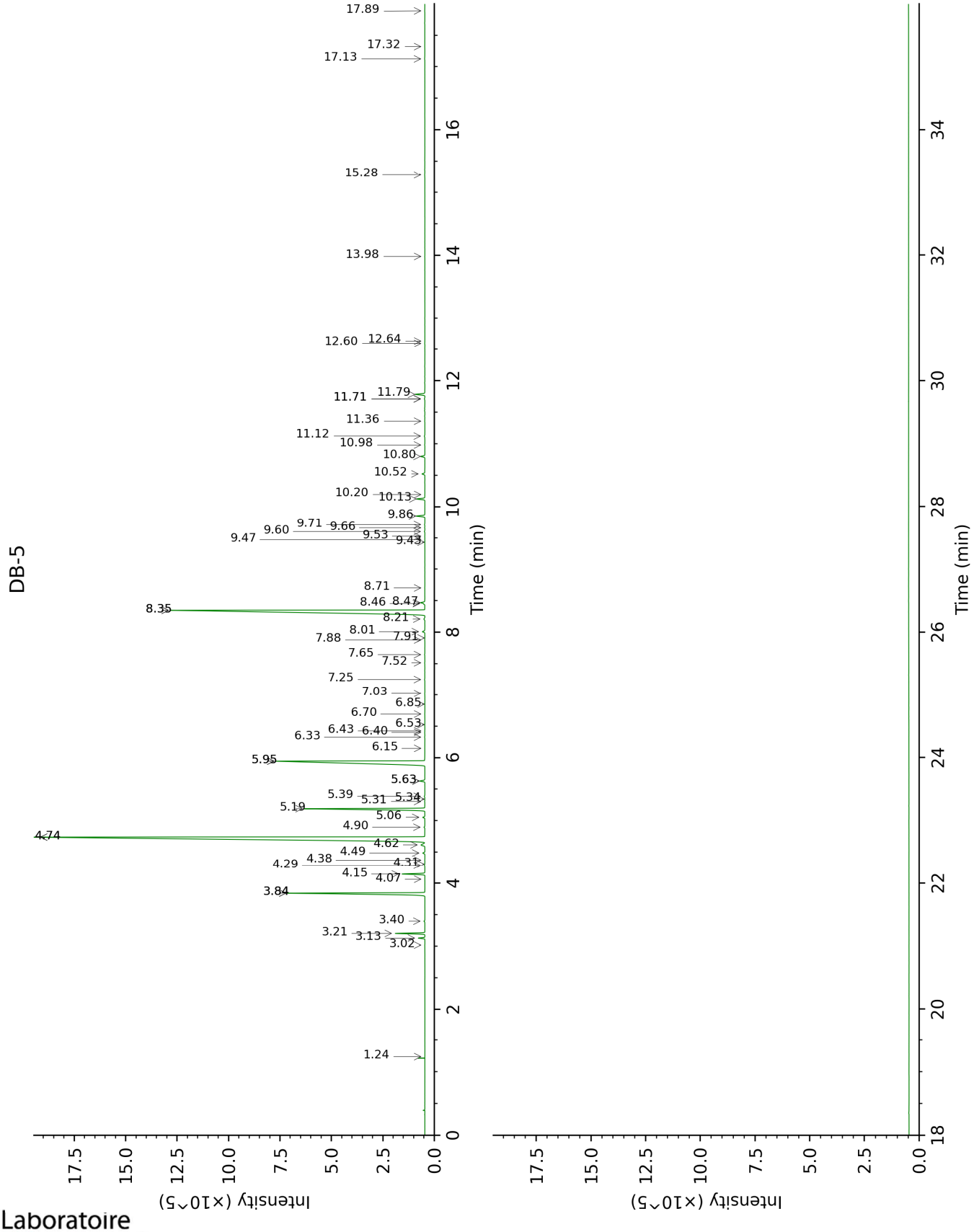
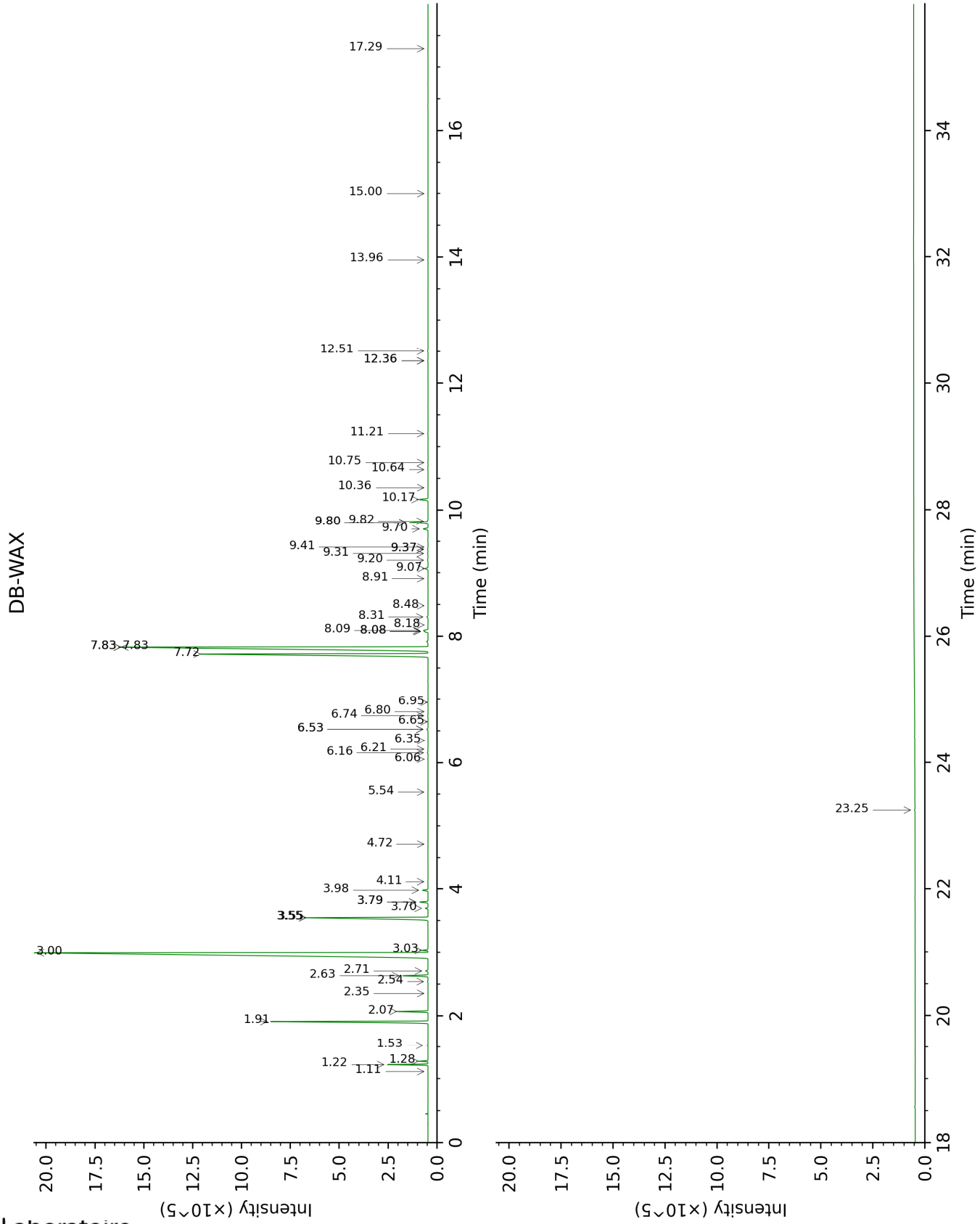

DB-5
17.89
17.32
17.13
15.28
13.98
12.60
12.64
11.71
11.79
11.36
11.12
10.98
10.80
10.52
10.20
10.13
9.86
9.71
9.66
9.60
9.53
9.47
9.43
8.71
8.46
8.47
8.35
8.21
8.01
7.91
7.88
7.65
7.52
7.25
7.03
6.85
6.70
6.53
6.43
6.40
6.33
6.15
5.95
5.63
5.39
5.34
5.31
5.19
5.06
4.90
4.74
4.62
4.49
4.38
4.31
4.29
4.15
4.07
3.84
3.40
3.21
3.13
3.02
1.24
Time (min)
Intensity (×10^5)


DB-WAX
Intensity (×10^5)
Time (min)
17.29
15.00
13.96
12.51
12.36
11.21
10.75
10.64
10.36
10.17
9.80
9.82
9.70
9.41
9.31
9.37
9.20
9.07
8.91
8.48
8.31
8.18
8.09
8.08
7.83
7.83
7.72
6.95
6.74
6.80
6.65
6.53
6.35
6.16
6.21
6.06
5.54
4.72
4.11
3.98
3.79
3.70
3.55
3.03
3.00
2.71
2.63
2.54
2.35
2.07
1.91
1.53
1.28
1.22
1.11
23.25

*FULL ANALYSIS DATA*

| Identification | Column DB-5 | | | Column DB-WAX | | |
|---|---|---|---|---|---|---|
| | R.T | R.I | % | R.T | R.I | % |
| Toluene | 1.24 | 759 | tr | | | |
| Tricyclene | 3.02 | 919 | 0.01 | 1.12 | 974 | tr |
| α-Thujene | 3.13 | 926 | 0.24 | 1.28 | 1002 | 0.25 |
| α-Pinene | 3.20 | 931 | 1.12 | 1.22 | 993 | 1.13 |
| Camphene | 3.40 | 944 | 0.04 | 1.53 | 1029 | 0.03 |
| Sabinene | 3.84* | 973 | 7.59 | 2.07 | 1085 | 1.03 |
| β-Pinene | 3.84* | 973 | [7.59] | 1.91 | 1068 | 6.57 |
| 6-Methyl-5-hepten-2-one | 4.06 | 987 | 0.01 | 4.72 | 1301 | tr |
| Myrcene | 4.15 | 993 | 0.94 | 2.63 | 1135 | 0.96 |
| α-Phellandrene | 4.29 | 1002 | 0.03 | 2.54 | 1127 | 0.03 |
| Octanal | 4.31 | 1004 | 0.02 | 4.11 | 1254 | 0.01 |
| Δ3-Carene | 4.38 | 1008 | 0.01 | 2.35 | 1112 | 0.01 |
| α-Terpinene | 4.49 | 1015 | 0.11 | 2.71 | 1141 | 0.11 |
| para-Cymene | 4.62 | 1023 | 0.32 | 3.79* | 1229 | 0.32 |
| Limonene | 4.74* | 1030 | 39.70 | 3.00 | 1165 | 39.65 |
| 1,8-Cineole | 4.74* | 1030 | [39.70] | 3.03 | 1168 | 0.19 |
| (*Z*)-β-Ocimene | 4.90 | 1040 | 0.05 | 3.55* | 1210 | 6.47 |
| (*E*)-β-Ocimene | 5.06 | 1050 | 0.11 | 3.70 | 1222 | 0.10 |
| γ-Terpinene | 5.19 | 1059 | 6.41 | 3.55* | 1210 | [6.47] |
| *cis*-Sabinene hydrate | 5.31 | 1066 | 0.02 | 6.53* | 1427 | 0.06 |
| para-Mentha-3,8-diene | 5.34 | 1068 | 0.01 | 3.79* | 1229 | [0.32] |
| *cis*-Linalool oxide (fur.) | 5.39 | 1071 | 0.03 | 6.16 | 1400 | 0.03 |
| Terpinolene | 5.63* | 1086 | 0.26 | 3.98 | 1244 | 0.22 |
| *trans*-Linalool oxide (fur.) | 5.63* | 1086 | [0.26] | 6.53* | 1427 | [0.06] |
| Linalool | 5.95* | 1106 | 14.48 | 7.72 | 1518 | 14.47 |
| Nonanal | 5.95* | 1106 | [14.48] | 5.54 | 1354 | 0.01 |
| *trans*-para-Mentha-2,8-dien-1-ol | 6.15 | 1119 | 0.01 | | | |
| *cis*-Limonene oxide | 6.33 | 1130 | 0.02 | 6.06 | 1392 | 0.01 |
| *trans*-Limonene oxide | 6.40 | 1135 | 0.01 | 6.21 | 1404 | 0.01 |
| Camphor | 6.43 | 1136 | 0.01 | 6.80 | 1448 | 0.01 |
| Epoxyterpinolene | 6.53 | 1143 | 0.01 | 6.35 | 1414 | tr |
| Citronellal | 6.70 | 1153 | 0.01 | 6.65 | 1436 | 0.01 |
| Borneol | 6.85 | 1163 | 0.01 | 9.37* | 1650 | 0.03 |
| Terpinen-4-ol | 7.03 | 1174 | 0.01 | 8.18 | 1554 | 0.01 |
| α-Terpineol | 7.25 | 1189 | 0.02 | 9.37* | 1650 | [0.03] |
| Decanal | 7.52 | 1206 | 0.02 | 6.95 | 1460 | 0.02 |
| Octyl acetate | 7.65 | 1214 | 0.02 | 6.74 | 1444 | 0.02 |
| Nerol | 7.88 | 1230 | 0.01 | 10.64 | 1757 | 0.01 |
| Citronellol | 7.91 | 1232 | 0.01 | 10.36 | 1732 | 0.01 |



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| | | | | | | |
|---|---|---|---|---|---|---|
| Neral | 8.01 | 1239 | 0.14 | 9.07 | 1625 | 0.15 |
| (*cis*?)-Linalool oxide acetate (fur.)? | 8.21 | 1252 | 0.07 | 7.83* | 1527 | 25.32 |
| Linalyl acetate | 8.35* | 1261 | 25.32 | 7.83* | 1527 | [25.32] |
| Geraniol | 8.35* | 1261 | [25.32] | 11.21 | 1806 | 0.02 |
| (*trans*?)-Linalool oxide acetate (fur.)? | 8.46 | 1268 | 0.05 | 8.31 | 1564 | 0.06 |
| Geranial | 8.47 | 1269 | 0.23 | 9.70 | 1677 | 0.23 |
| Bornyl acetate | 8.70 | 1285 | 0.01 | 7.83* | 1527 | [25.32] |
| para-Mentha-1,8-diene-4-hydroperoxide | 9.43 | 1335 | 0.01 | | | |
| Linalyl propionate | 9.47 | 1338 | 0.01 | 8.48 | 1578 | 0.01 |
| Hodiendiol derivative | 9.52 | 1342 | 0.01 | 12.51 | 1924 | 0.03 |
| α-Terpinyl acetate | 9.60 | 1347 | 0.03 | 9.31 | 1645 | 0.03 |
| Unknown [m/z 43, 121 (52), 93 (48), 79 (33), 41 (30), 136 (26), 81 (25)...] | 9.66 | 1351 | 0.01 | | | |
| Unknown [m/z 43, 79 (46), 71 (30), 94 (25), 41 (23), 81 (21)... 197 (0)] | 9.71 | 1355 | 0.02 | 10.75 | 1766 | 0.02 |
| Neryl acetate | 9.86 | 1365 | 0.43 | 9.80* | 1686 | 0.92 |
| Geranyl acetate | 10.13 | 1384 | 0.41 | 10.17 | 1716 | 0.41 |
| β-Elemene | 10.20 | 1389 | 0.01 | 8.08*† | 1546 | 0.34 |
| β-Caryophyllene | 10.52 | 1412 | 0.16 | 8.08*† | 1546 | [0.34] |
| *trans*-α-Bergamotene | 10.80 | 1433 | 0.21 | 8.09† | 1548 | [0.34] |
| α-Humulene | 10.98 | 1446 | 0.02 | 8.91 | 1612 | 0.01 |
| (*E*)-β-Farnesene | 11.12 | 1457 | 0.03 | 9.20 | 1636 | 0.05 |
| Germacrene D | 11.36 | 1475 | 0.01 | 9.41 | 1653 | 0.01 |
| (*Z*)-α-Bisabolene | 11.71* | 1501 | 0.03 | 9.82 | 1687 | 0.02 |
| Hodiendiol derivative II | 11.71* | 1501 | [0.03] | 12.36* | 1909 | 0.02 |
| β-Bisabolene | 11.79 | 1506 | 0.50 | 9.80* | 1686 | [0.92] |
| Spathulenol | 12.60 | 1570 | 0.01 | 13.96 | 2061 | 0.01 |
| Caryophyllene oxide | 12.64 | 1573 | 0.01 | 12.36* | 1909 | [0.02] |
| α-Bisabolol | 13.98 | 1683 | 0.01 | 15.00 | 2166 | 0.01 |
| Nootkatone | 15.28 | 1794 | 0.02 | 17.29 | 2410 | 0.01 |
| Citropten | 17.13 | 1964 | 0.02 | 23.25 | 3163 | 0.02 |
| para-Camphorene | 17.32 | 1982 | 0.01 | | | |
| Bergapten | 17.89 | 2037 | 0.01 | | | |



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| | | |
|---|---|---|
| **Total identified** | **99.46%** | **99.48%** |
| **Total reported** | **99.49%** | **99.50%** |

*: 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
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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