

## GC/MS BATCH NUMBER: BS0102

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**ESSENTIAL OIL:** BLACK PEPPER ORGANIC  
**BOTANICAL NAME:** PIPER NIGRUM  
**ORIGIN:** SRI LANKA

KEY CONSTITUENTS PRESENT IN THIS BATCH OF BLACK PEPPER ORGANIC OIL	%
β-CARYOPHYLLENE	17.7
LIMONENE	15.4
SABINENE	14.5
α-PINENE	13.0
β-PINENE	11.6
Δ3-CARENE	6.2
α-COPAENE	2.7
1,8-CINEOLE + β-PHELLANDRENE	2.4
MYRCENE	2.2
α-THUJENE	1.8
β-BISABOLENE	1.5
δ-ELEMENE + BICYCLOELEMENE	1.4
α-PHELLANDRENE	1.4

Comments from Robert Tisserand: Beautiful fresh, spicy odor quality, with hints of pink and green Peppercorns. Eleven of twelve ISO standards are within range, with slightly low alpha-selinene.

**Date :** October 18, 2018

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 18J11-PTH1-1-CC

**Customer identification :** Black Pepper Organic - Sri Lanka - BS010288R

**Type :** Essential oil

**Source :** *Piper nigrum*

**Customer :** Plant Therapy

**ANALYSIS**

**Method:** PC-PA-014-17J19 - Analysis of the composition of an essential oil, or other volatile liquid, by FAST GC-FID (in French); identifications validated by GC-MS.

**Analyst :** Lindsay Girard, B. Sc.

**Analysis date :** October 12, 2018

Checked and approved by :

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

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*This report is digitally signed, it is only considered valid if the digital signature is intact.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Clear liquid

**Refractive index:**  $1.4780 \pm 0.0003$  (20 °C)

*CONCLUSION*

No adulterant, contaminant or diluent has been detected using this method.

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Isovaleral	0.01	0.01	Aliphatic aldehyde
2-Methylbutyral	tr	tr	Aliphatic aldehyde
$\alpha$ -Thujene	1.75	14.67*	Monoterpene
$\alpha$ -Pinene	12.95	[14.67]*	Monoterpene
Camphene	0.37*	0.33	Monoterpene
$\alpha$ -Fenchene	[0.37]*	0.01	Monoterpene
Thuja-2,4(10)-diene	0.01	14.60*	Monoterpene
Sabinene	26.02*	[14.60]*	Monoterpene
$\beta$ -Pinene	[26.02]*	11.56	Monoterpene
Myrcene	2.19	2.22	Monoterpene
$\alpha$ -Phellandrene	1.35	1.38	Monoterpene
$\Delta^3$ -Carene	6.23	6.25	Monoterpene
$\alpha$ -Terpinene	0.15	0.11	Monoterpene
ortho-Cymene	0.02	0.30*	Simple phenolic
para-Cymene	0.22	[0.30]*	Monoterpene
Limonene	17.86*	15.42	Monoterpene
1,8-Cineole	[17.86]*	2.29*	Monoterpenic ether
$\beta$ -Phellandrene	[17.86]*	[2.29]*	Monoterpene
(Z)- $\beta$ -Ocimene	0.05	0.05	Monoterpene
(E)- $\beta$ -Ocimene	0.21	0.21	Monoterpene
$\gamma$ -Terpinene	0.20	0.20	Monoterpene
cis-Sabinene hydrate	0.12	1.45*	Monoterpenic alcohol
Isoterpinolene	0.06	0.09	Monoterpene
para-Cymenene	0.39*	0.01	Monoterpene
Terpinolene	[0.39]*	0.35	Monoterpene
$\alpha$ -Pinene oxide	0.01		Monoterpenic ether
trans-Sabinene hydrate	0.08	0.08	Monoterpenic alcohol
Linalool	0.25	0.26	Monoterpenic alcohol
Verbenol analog?	0.01	0.11	Monoterpenic alcohol
trans-para-Mentha-2,8-dien-1-ol	0.03	0.03	Monoterpenic alcohol
cis-para-Mentha-2,8-dien-1-ol	0.01	0.03*	Monoterpenic alcohol
trans-Verbenol	0.01	[0.03]*	Monoterpenic alcohol
meta-Mentha-4,6-dien-8-ol	0.01	0.03	Monoterpenic alcohol
Borneol	0.01	0.01	Monoterpenic alcohol
Terpinen-4-ol	0.22	0.23*	Monoterpenic alcohol
meta-Cymen-8-ol	0.02*	0.01	Monoterpenic alcohol
Cryptone	[0.02]*	0.01	Normoterpenic ketone
Myrtenal	0.06*	[0.23]*	Monoterpenic aldehyde
$\alpha$ -Terpineol	[0.06]*	[0.53]	Monoterpenic alcohol
Unknown	0.02	0.01	Oxygenated monoterpene
trans-Carveol	0.01	0.01	Monoterpenic alcohol
cis-Carveol	0.01		Monoterpenic alcohol
Unknown	0.01	0.01	Unknown
Unknown	0.02		Oxygenated monoterpene
$\delta$ -Elemene	1.37*	[1.45]*	Sesquiterpene
Bicycloelemene	[1.37]*	2.64*	Sesquiterpene
$\alpha$ -Cubebene	0.17	0.16	Sesquiterpene
Cyclosativene I	0.10*	0.08	Sesquiterpene

Cyclosativene II	[0.10]*	0.01	Sesquiterpene
α-Copaene	2.68	[2.64]*	Sesquiterpene
cis-β-Elemene	0.01	0.02	Sesquiterpene
β-Cubebene	0.27	0.28	Sesquiterpene
β-Elemene	0.26	17.70*	Sesquiterpene
β-Caryophyllene	17.65	[17.70]*	Sesquiterpene
β-Copaene	0.15	[17.70]*	Sesquiterpene
α-Guaiene	0.05*	[17.70]*	Sesquiterpene
trans-α-Bergamotene	[0.05]*	0.01	Sesquiterpene
Unknown	0.04		Sesquiterpene
α-Humulene	0.84	0.84*	Sesquiterpene
(E)-β-Farnesene	0.18*	0.14	Sesquiterpene
β-Santalene	[0.18]*	0.01	Sesquiterpene
trans-Cadina-1(6),4-diene	0.03	[0.84]*	Sesquiterpene
Germacrene D	0.39*	0.53	Sesquiterpene
γ-Muurolene	[0.39]*	0.07	Sesquiterpene
β-Selinene	0.17	0.16	Sesquiterpene
epi-Cubebol	0.37*	0.09	Sesquiterpenic alcohol
Bicyclogermacrene	[0.37]*	0.21	Sesquiterpene
Viridiflorene	[0.37]*	0.04	Sesquiterpene
α-Selinene	[0.37]*	0.11	Sesquiterpene
α-Muurolene	0.39	0.23	Sesquiterpene
β-Bisabolene	1.46	1.40	Sesquiterpene
Cubebol	0.17	0.16	Sesquiterpenic alcohol
7-epi-α-Selinene	0.08	0.09	Sesquiterpene
trans-Calamenene	0.93*	0.04	Sesquiterpene
δ-Cadinene	[0.93]*	0.87	Sesquiterpene
α-Calacorene	0.01	0.03*	Sesquiterpene
(E)-α-Bisabolene	0.03	0.03	Sesquiterpene
Isocaryophyllene epoxide B	0.03	[0.03]*	Sesquiterpenic ether
Unknown	0.03	0.01	Aliphatic alcohol
(E)-Nerolidol	0.05	0.06	Sesquiterpenic alcohol
Caryophyllene oxide	0.28*	0.22	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.28]*	0.05	Sesquiterpenic ether
Humulene epoxide I	0.01	0.01	Sesquiterpenic ether
Humulene epoxide II	0.02		Sesquiterpenic ether
α-Corocalene	0.01	0.01	Sesquiterpene
Caryophylladienol I	0.07*	0.01	Sesquiterpenic alcohol
Guaia-6,10(14)-dien-4β-ol	[0.07]*	0.07	Sesquiterpenic alcohol
τ-Muurolol	0.04	0.03	Sesquiterpenic alcohol
α-Muurolol	0.13	0.12	Sesquiterpenic alcohol
cis-Calamenen-10-ol	0.01	0.01	Sesquiterpenic alcohol
α-Bisabolol	0.01	0.01	Sesquiterpenic alcohol
<b>Total identified</b>	<b>99.34%</b>	<b>98.89%</b>	

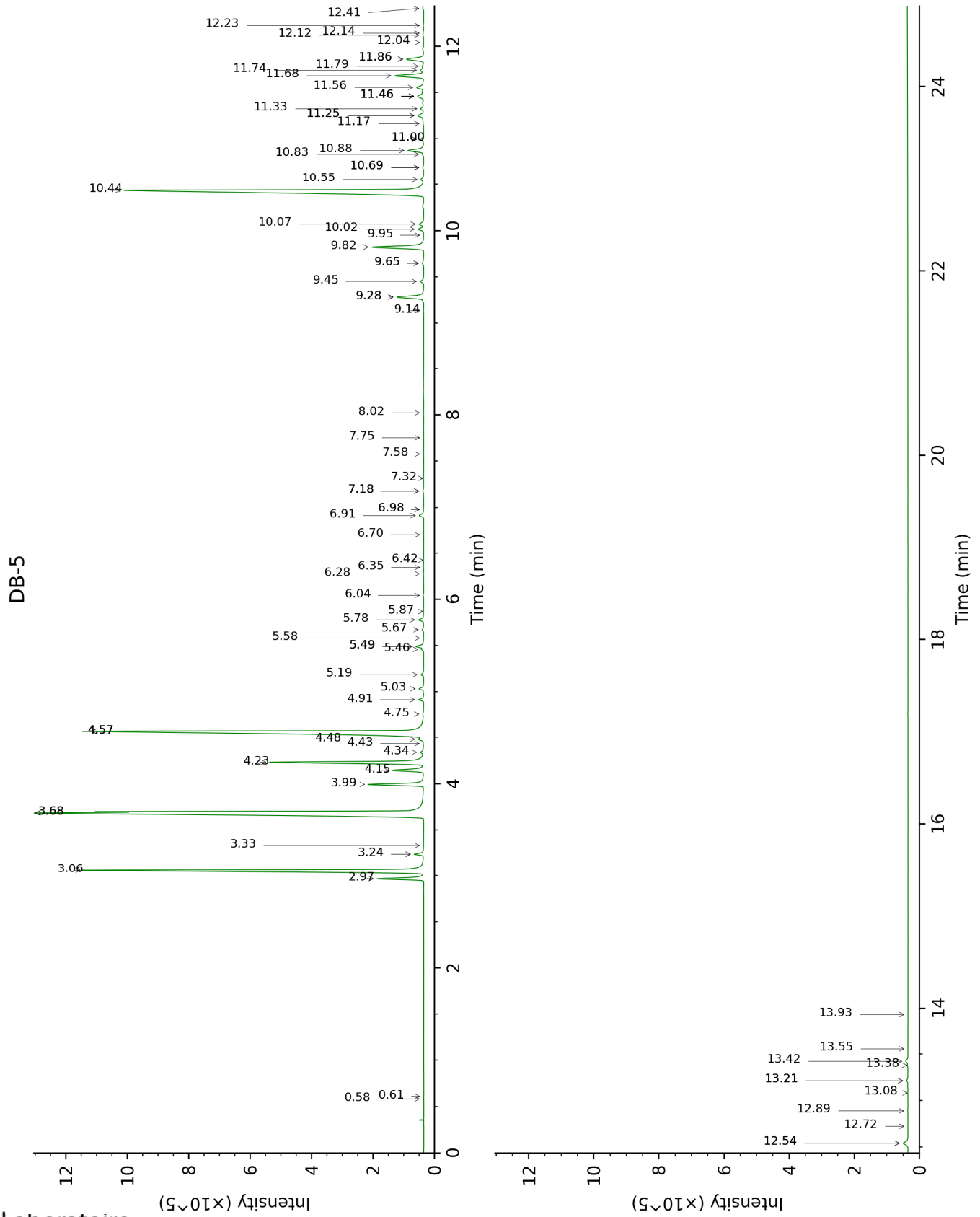
\*: Two or more compounds are coeluting on this column

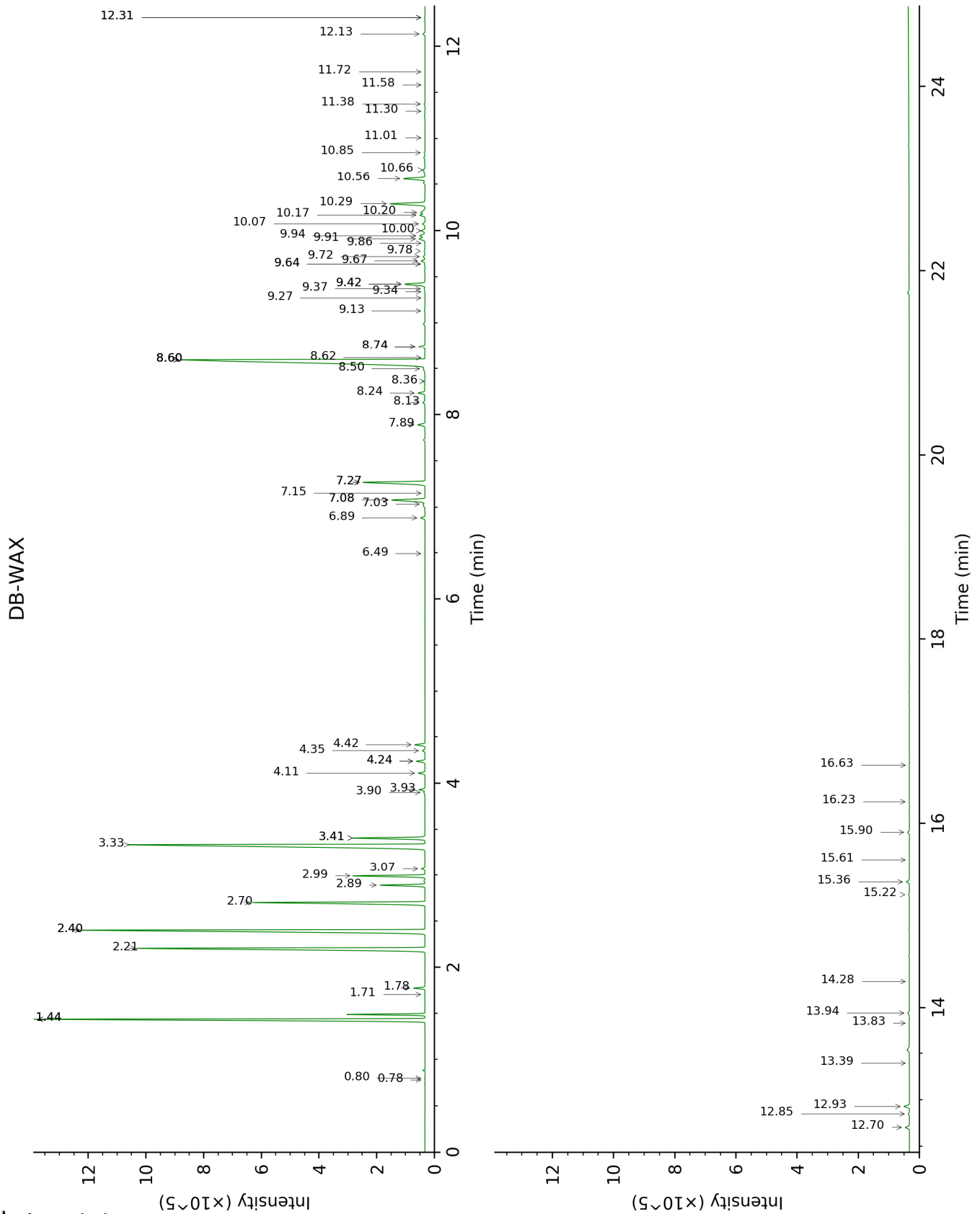
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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

Note: no correction factor was applied

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FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.58	638	0.01	0.80	890	0.01
2-Methylbutyral	0.61	647	tr	0.78	884	tr
α-Thujene	2.97	925	1.75	1.44*	994	14.67
α-Pinene	3.06	931	12.95	1.44*	994	[14.67]
Camphene	3.24*	942	0.37	1.78	1028	0.33
α-Fenchene	3.24*	942	[0.37]	1.71	1022	0.01
Thuja-2,4(10)-diene	3.33	949	0.01	2.40*	1088	14.60
Sabinene	3.68*†	972	26.02	2.40*	1088	[14.60]
β-Pinene	3.68*†	972	[26.02]	2.21	1069	11.56
Myrcene	3.99	992	2.19	2.99	1135	2.22
α-Phellandrene	4.15	1002	1.35	2.89	1127	1.38
Δ <sup>3</sup> -Carene	4.23	1007	6.23	2.70	1113	6.25
α-Terpinene	4.34	1014	0.15	3.07	1141	0.11
ortho-Cymene	4.43	1020	0.02	4.24*	1231	0.30
para-Cymene	4.48	1023	0.22	4.24*	1231	[0.30]
Limonene	4.57*	1028	17.86	3.34	1162	15.42
1,8-Cineole	4.57*	1028	[17.86]	3.41*	1168	2.29
β-Phellandrene	4.57*	1028	[17.86]	3.41*	1168	[2.29]
(Z)-β-Ocimene	4.75	1039	0.05	3.90	1206	0.05
(E)-β-Ocimene	4.91	1049	0.21	4.11	1221	0.21
γ-Terpinene	5.03	1057	0.20	3.93	1208	0.20
cis-Sabinene hydrate	5.19	1066	0.12	7.08*	1433	1.45
Isoterpinolene	5.46	1083	0.06	4.35	1239	0.09
para-Cymenene	5.49*	1085	0.39	6.49	1390	0.01
Terpinolene	5.49*	1085	[0.39]	4.42	1244	0.35
α-Pinene oxide	5.58	1090	0.01			
trans-Sabinene hydrate	5.67	1096	0.08	8.13	1512	0.08
Linalool	5.78	1103	0.25	8.24	1520	0.26
Verbenol analog?	5.87	1108	0.01	8.50	1540	0.11
trans-para-Mentha-2,8-dien-1-ol	6.04	1119	0.03	9.13	1588	0.03
cis-para-Mentha-2,8-dien-1-ol	6.28	1134	0.01	9.64*	1629	0.03
trans-Verbenol	6.35	1138	0.01	9.64*	1629	[0.03]
meta-Mentha-4,6-dien-8-ol	6.42	1143	0.01	9.37	1607	0.03
Borneol	6.70	1161	0.01	9.86	1647	0.01
Terpinen-4-ol	6.91	1174	0.22	8.74*	1558	0.23
meta-Cymen-8-ol	6.98*	1178	0.02	11.72	1802	0.01
Cryptone	6.98*	1178	[0.02]	9.27	1599	0.01
Myrtenal	7.18*	1191	0.06	8.74*	1558	[0.23]
α-Terpineol	7.18*	1191	[0.06]	9.94†	1653	[0.53]
Unknown [m/z 109, 91 (100), 81	7.32	1200	0.02	11.01	1741	0.01

(88), 94 (75), 119 (74), 96 (73), 41 (63)... 150 (2)]						
<i>trans</i> -Carveol	7.58	1217	0.01	11.58	1789	0.01
<i>cis</i> -Carveol	7.76	1229	0.01			
Unknown [m/z 43, 97 (69), 107 (46), 41 (28), 55 (21), 109 (20)...]	8.02	1246	0.01	11.30	1766	0.01
Unknown [m/z 91, 79 (94), 77 (72), 41 (37), 93 (31)... 152 (1)]	9.14	1323	0.02			
δ-Elemene	9.28*	1333	1.37	7.08*	1433	[1.45]
Bicycloelemene	9.28*	1333	[1.37]	7.27*	1447	2.64
α-Cubebene	9.45	1345	0.17	6.89	1419	0.16
Cyclosativene I	9.65*	1358	0.10	7.03	1430	0.08
Cyclosativene II	9.65*	1358	[0.10]	7.15	1439	0.01
α-Copaene	9.82	1370	2.68	7.27*	1447	[2.64]
<i>cis</i> -β-Elemene	9.95	1379	0.01	8.36	1529	0.02
β-Cubebene	10.02	1384	0.27	7.89	1493	0.28
β-Elemene	10.07	1387	0.26	8.60*	1547	17.70
β-Caryophyllene	10.44	1413	17.65	8.60*	1547	[17.70]
β-Copaene	10.55	1422	0.15	8.60*	1547	[17.70]
α-Guaiene	10.69*	1432	0.05	8.60*	1547	[17.70]
<i>trans</i> -α- Bergamotene	10.69*	1432	[0.05]	8.62	1549	0.01
Unknown [m/z 139, 69 (60), 41 (51), 43 (47), 119 (41)... 204 (1)]	10.83	1442	0.04			
α-Humulene	10.88	1445	0.84	9.42*	1611	0.84
( <i>E</i> )-β-Farnesene	11.00*	1454	0.18	9.67	1632	0.14
β-Santalene	11.00*	1454	[0.18]	9.34	1605	0.01
<i>trans</i> -Cadina- 1(6),4-diene	11.17	1467	0.03	9.42*	1611	[0.84]
Germacrene D	11.25*	1473	0.39	9.91†	1651	0.53
γ-Murolene	11.25*	1473	[0.39]	9.72	1635	0.07
β-Selinene	11.33	1478	0.17	10.00	1658	0.16
epi-Cubebol	11.46*	1488	0.37	12.13	1838	0.09
Bicyclogermacrene	11.46*	1488	[0.37]	10.17	1671	0.21
Viridiflorene	11.46*	1488	[0.37]	9.78	1640	0.04
α-Selinene	11.46*	1488	[0.37]	10.07	1664	0.11
α-Murolene	11.56	1495	0.39	10.20	1674	0.23
β-Bisabolene	11.68	1505	1.46	10.29	1681	1.40
Cubebol	11.74	1509	0.17	12.70	1888	0.16
7-epi-α-Selinene	11.79	1513	0.08	10.66	1712	0.09
<i>trans</i> -Calamenene	11.86*	1519	0.93	11.38	1772	0.04
δ-Cadinene	11.86*	1519	[0.93]	10.56	1704	0.87
α-Calacorene	12.04	1533	0.01	12.31*	1853	0.03
( <i>E</i> )-α-Bisabolene	12.12	1539	0.03	10.85	1728	0.03
Isocaryophyllene	12.14	1540	0.03	12.31*	1853	[0.03]

epoxide B						
Unknown [m/z 91, 41 (97), 107 (96), 93 (95), 133 (88), 69 (88), 149 (84)... 218 (19)]	12.23	1547	0.03	14.28	2034	0.01
(E)-Nerolidol	12.42	1561	0.05	13.94	2002	0.06
Caryophyllene oxide	12.54*	1571	0.28	12.93	1908	0.22
Caryophyllene oxide isomer	12.54*	1571	[0.28]	12.85	1901	0.05
Humulene epoxide I	12.72	1585	0.01	13.39	1951	0.01
Humulene epoxide II	12.89	1598	0.02			
α-Corocalene	13.08	1614	0.01	13.83	1991	0.01
Caryophylladienol I	13.21*	1624	0.07	16.24	2228	0.01
Guaia-6,10(14)-dien-4β-ol	13.21*	1624	[0.07]	15.90	2194	0.07
τ-Muurolol	13.38	1638	0.04	15.22	2126	0.03
α-Muurolol	13.42	1641	0.13	15.36	2139	0.12
cis-Calamenen-10-ol	13.56	1652	0.01	16.63	2269	0.01
α-Bisabolol	13.93	1683	0.01	15.60	2164	0.01
<b>Total identified</b>		<b>99.34%</b>			<b>98.89%</b>	
<b>Total reported</b>		<b>99.47%</b>			<b>98.92%</b>	

\*: Two or more compounds are coeluting on this column

[xx]: Duplicate percentage due to coelutions, not taken account in the identified 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