Date : September 26, 2019

Certificate of Analysis – GC Profiling

Sample identification

Internal code : 19I13-PTH06-1-SCC
Customer identification : Cardamom - Guatemala - CA310591R
Type : Essential oil
Source : *Elettaria cardamomum*
Customer : Plant Therapy

Analysis

Method: PC-PA-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 : September 23, 2019

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

Physical aspect: Faintly yellow liquid
Refractive index: 1.4632 ± 0.0003 (20 °C)

ISO 4733:2004 - OIL OF CARDAMOM - CENTRAL AMERICA

Compound	Min. %	Max. %	Observed %	Complies?
(E)-Nerolidol	0.5	1.0	0.8	Yes
α-Terpinyl acetate	35	45	39	Yes
α-Terpineol	tr	2.50	1.25	Yes
Terpinen-4-ol	0.8	1.5	0.9	Yes
Linalyl acetate	4	6	4	Yes
Linalool	3	6	4	Yes
1,8-Cineole	27	35	29	Yes
Limonene	2.0	3.0	3.2	No
Myrcene	tr	2.50	1.99	Yes
Sabinene	3	5	5	Yes
α-Pinene	1.0	2.0	1.6	Yes
Refractive index	1.4600	1.4670	1.4632	Yes

CONCLUSION

No adulterant, contaminant or diluent has been detected using this method. The oil marginally does not comply with the ISO standard for Central American cardamom oil.

Analysis summary – Consolidated contents

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

Identification	%	Classe
Isobutyral	tr	Aliphatic aldehyde
2-Methyl-3-buten-2-ol	tr	Aliphatic alcohol
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	0.01	Aliphatic aldehyde
Isoamyl alcohol	0.01	Aliphatic alcohol
2-Methylbutanol	0.01	Aliphatic alcohol
Hexanal	0.01	Aliphatic aldehyde
Hexanol	0.01	Aliphatic alcohol
Isoamyl acetate	0.01	Aliphatic ester
2-Methylbutyl acetate	0.01	Aliphatic ester
Heptanal	tr	Aliphatic aldehyde
α-Thujene	0.22	Monoterpene
α-Pinene	1.56	Monoterpene
Camphene	0.03	Monoterpene
α-Fenchene	0.01	Monoterpene
Sabinene	4.69	Monoterpene
β-Pinene	0.50	Monoterpene
6-Methyl-5-hepten-2-one	0.03	Aliphatic ketone
Methyl 2-hydroxy-3-methylvalerate	0.04	Aliphatic ester
Myrcene	1.99	Monoterpene
α-Phellandrene	0.03	Monoterpene
Octanal	0.10	Aliphatic aldehyde
Δ3-Carene	0.01	Monoterpene
α-Terpinene	0.13	Monoterpene
para-Cymene	0.14	Monoterpene
1,8-Cineole	28.57	Monoterpenic ether
Limonene	3.19	Monoterpene
(*Z*)-β-Ocimene	0.04	Monoterpene
(*E*)-β-Ocimene	0.10	Monoterpene
γ-Terpinene	0.29	Monoterpene
cis-Sabinene hydrate	0.40	Monoterpenic alcohol
cis-Linalool oxide (fur.)	0.03	Monoterpenic alcohol
Octanol	0.06	Aliphatic alcohol
Terpinolene	0.15	Monoterpene
trans-Linalool oxide (fur.)	tr	Monoterpenic alcohol
para-Cymenene	0.01	Monoterpene
6,7-Epoxymyrcene	0.03	Monoterpenic ether
trans-Sabinene hydrate	0.25	Monoterpenic alcohol
Linalool	3.95	Monoterpenic alcohol
(*E*)-4,8-Dimethylnona-1,3,7-triene	0.09	Terpene derivative
cis-para-Menth-2-en-1-ol	0.03	Monoterpenic alcohol
cis-para-Mentha-2,8-dien-1-ol	0.02	Monoterpenic alcohol
trans-para-Menth-2-en-1-ol	0.02	Monoterpenic alcohol
Borneol	0.02	Monoterpenic alcohol
δ-Terpineol	0.09	Monoterpenic alcohol
Terpinen-4-ol	0.95	Monoterpenic alcohol
para-Cymen-8-ol	0.02	Monoterpenic alcohol

α-Terpineol	1.25	Monoterpenic alcohol
Myrtenal	0.02	Monoterpenic aldehyde
γ-Terpineol	0.08	Monoterpenic alcohol
Decanal	0.05	Aliphatic aldehyde
Octyl acetate	0.11	Aliphatic ester
cis-Sabinene hydrate acetate?	0.66	Monoterpenic ester
cis-Carveol	0.01	Monoterpenic alcohol
Unknown	0.01	Unknown
Neral	0.23	Monoterpenic aldehyde
(2*E*)-Decenal	0.02	Aliphatic aldehyde
Geraniol	0.95	Monoterpenic alcohol
Linalyl acetate	4.47	Monoterpenic ester
Geranial	0.32	Monoterpenic aldehyde
Bornyl acetate	0.04	Monoterpenic ester
Terpinen-4-yl acetate	0.01	Monoterpenic ester
Geranyl formate	0.01	Monoterpenic ester
δ-Terpinyl acetate	0.14	Monoterpenic ester
Methyl geranate	0.08	Monoterpenic ester
δ-Elemene	0.01	Sesquiterpene
α-Terpinyl acetate	38.78	Monoterpenic ester
Neryl acetate	0.03	Monoterpenic ester
α-Copaene	0.02	Sesquiterpene
Methyl (*E*)-cinnamate	0.01	Phenylpropanoid ester
Geranyl acetate	0.78	Monoterpenic ester
Dodecenyl acetate isomer?	0.04	Aliphatic ester
Dodecenal isomer	0.09	Aliphatic aldehyde
β-Elemene	0.01	Sesquiterpene
β-Caryophyllene	0.05	Sesquiterpene
α-Terpinyl propionate	0.07	Monoterpenic ester
Unknown	0.02	Sesquiterpene
Geranylacetone	0.01	Monoterpenic ketone
8-Acetoxy-*trans*-para-Menth-2-en-1-ol [2-(4-Hydroxy-4-methylcyclohex-2-enyl)propan-2-yl acetate]	0.02	Monoterpenic ester
Germacrene D	0.06	Sesquiterpene
β-Selinene	0.25	Sesquiterpene
Geranyl propionate	0.01	Monoterpenic ester
α-Selinene	0.09	Sesquiterpene
δ-Amorphene	0.02	Sesquiterpene
γ-Cadinene	0.11	Sesquiterpene
δ-Cadinene	0.04	Sesquiterpene
Unknown	tr	Unknown
Germacrene B	0.07	Sesquiterpene
(*E*)-Nerolidol	0.79	Sesquiterpenic alcohol
Dendrolasin	0.01	Sesquiterpenic ether
(3*E*,7*E*)-4,8,12-Trimethyl-1,3,7,11-tridecatetraene	0.13	Terpene derivative
Unknown	0.02	Oxygenated sesquiterpene
Unknown	0.02	Unknown
Unknown	0.01	Unknown
Unknown	0.01	Oxygenated sesquiterpene
(2*E*,6*Z*)-Farnesal	0.11	Sesquiterpenic aldehyde

(2*E*,6*E*)-Farnesol	0.13	Sesquiterpenic alcohol
(2*E*,6*E*)-Farnesal	0.05	Sesquiterpenic aldehyde
γ-Bicyclohomofarnesal	0.02	Terpenic aldehyde
(2*E*,6*E*)-Farnesyl acetate	0.03	Sesquiterpenic ester
Coronarin *E*	0.06	Diterpene
Consolidated total	**98.27%**	

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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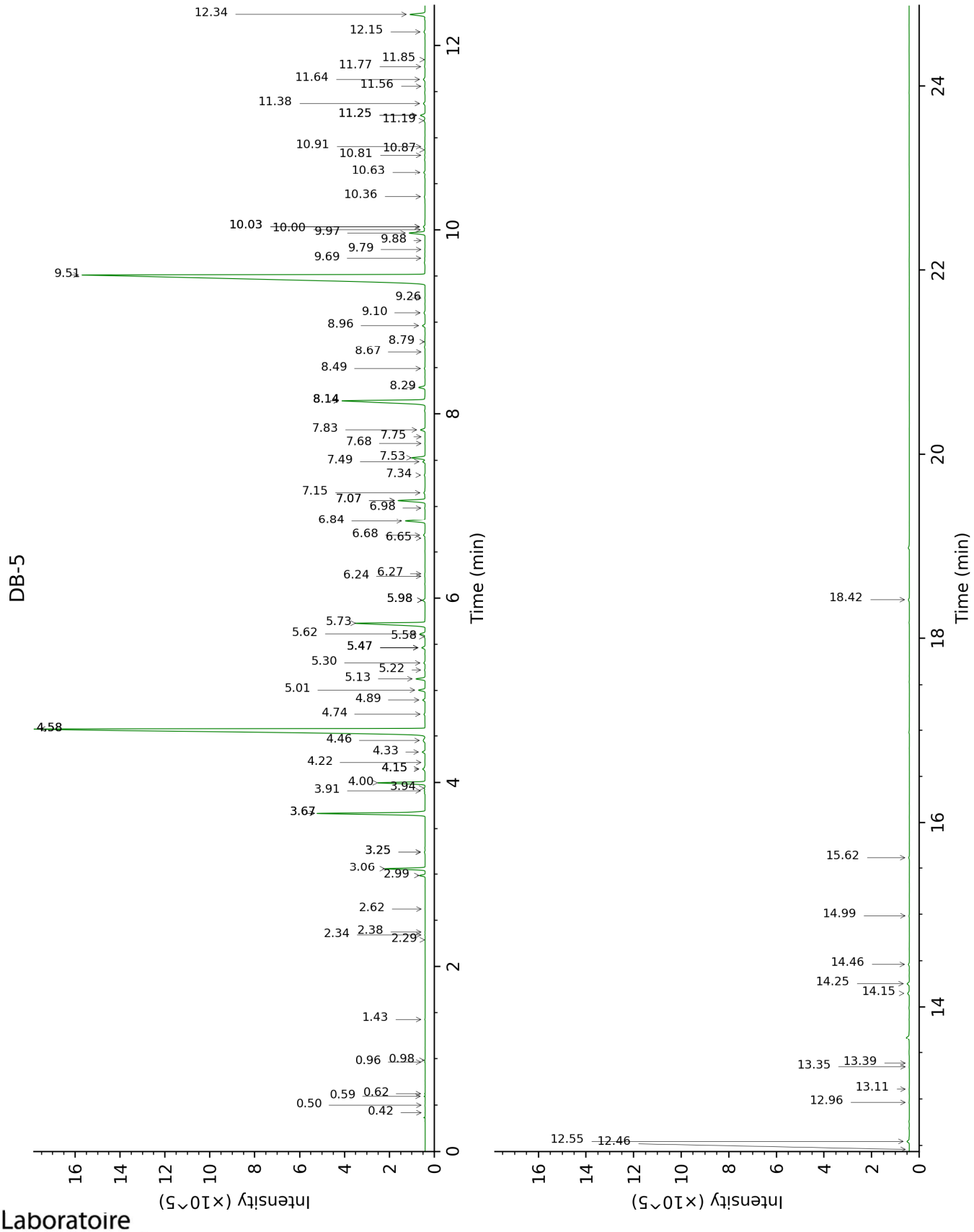
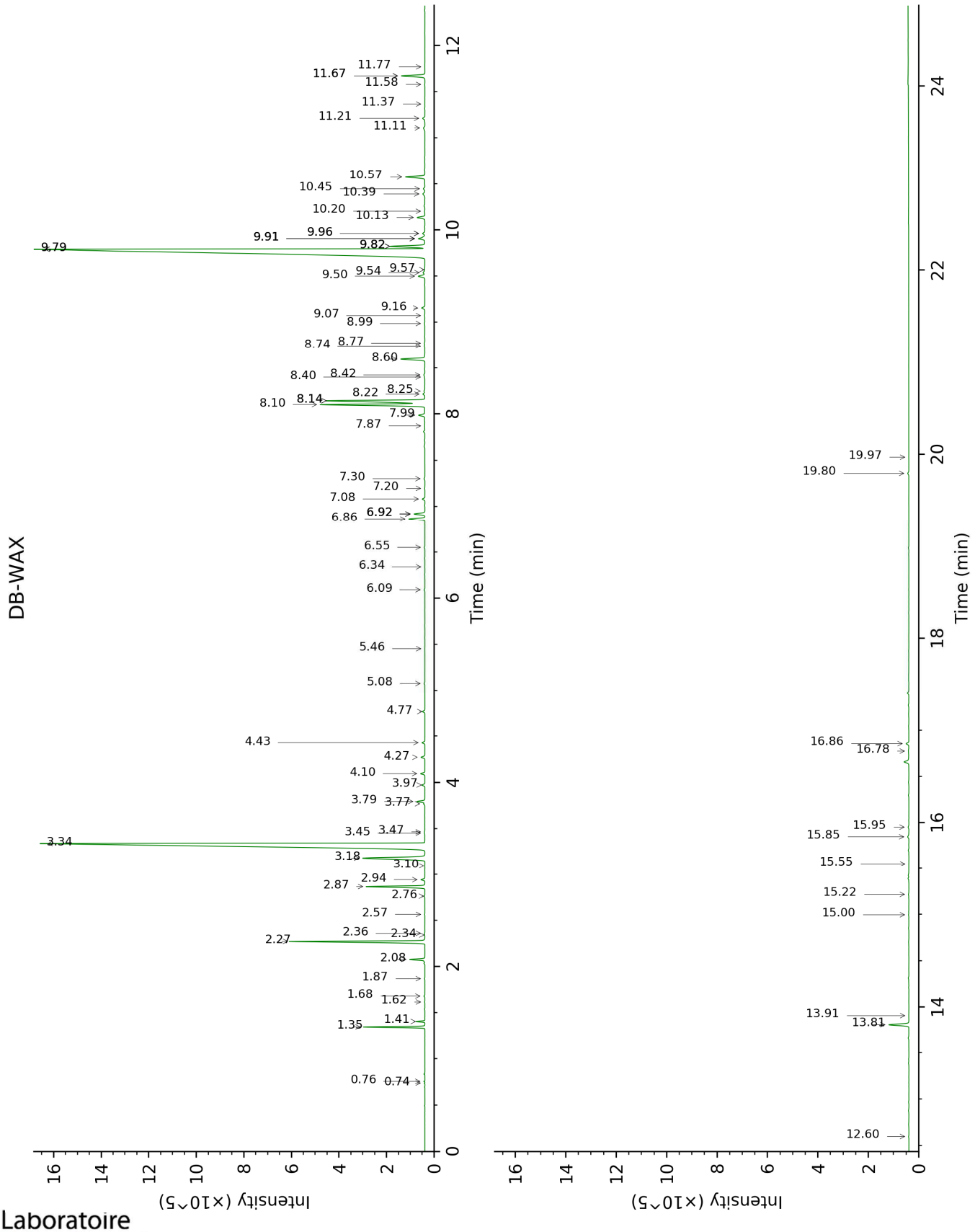

DB-5
12.34
12.15
11.85
11.77
11.64
11.56
11.38
11.25
11.19
10.91
10.87
10.81
10.63
10.36
10.03
10.00
9.97
9.88
9.79
9.69
9.51
9.26
9.10
8.96
8.79
8.67
8.49
8.29
8.14
7.83
7.75
7.68
7.53
7.49
7.34
7.15
7.07
6.98
6.84
6.68
6.65
6.27
6.24
5.98
5.73
5.62
5.58
5.47
5.30
5.22
5.13
5.01
4.89
4.74
4.58
4.46
4.33
4.22
4.15
4.00
3.94
3.91
3.67
3.25
3.06
2.99
2.62
2.38
2.34
2.29
1.43
0.98
0.96
0.62
0.59
0.50
0.42
Time (min)
Intensity (×10^5)
18.42
15.62
14.99
14.46
14.25
14.15
13.39
13.35
13.11
12.96
12.55
12.46
Time (min)
Intensity (×10^5)


DB-WAX
Time (min)
Intensity (×10^5)
11.77
11.67
11.58
11.37
11.21
11.11
10.57
10.45
10.39
10.20
10.13
9.96
9.91
9.82
9.79
9.57
9.54
9.50
9.16
9.07
8.99
8.77
8.74
8.60
8.42
8.40
8.25
8.22
8.14
8.10
7.99
7.87
7.30
7.20
7.08
6.92
6.86
6.55
6.34
6.09
5.46
5.08
4.77
4.43
4.27
4.10
3.97
3.79
3.77
3.47
3.45
3.34
3.18
3.10
2.94
2.87
2.76
2.57
2.36
2.34
2.27
2.08
1.87
1.68
1.62
1.41
1.35
0.76
0.74
19.97
19.80
16.86
16.78
15.95
15.85
15.55
15.22
15.00
13.91
13.81
12.60

FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isobutyral	0.42	531	tr			
2-Methyl-3-buten-2-ol	0.50	591	tr			
Isovaleral	0.60	640	0.01	0.76	886	0.02
2-Methylbutyral	0.62	650	0.01	0.74	880	0.01
Isoamyl alcohol	0.96	735	0.01	3.47	1178	0.01
2-Methylbutanol	0.98	738	0.01	3.45	1177	0.01
Hexanal	1.43	799	0.01	1.87	1043	0.01
Hexanol	2.29	873	0.01	5.46	1324	0.01
Isoamyl acetate	2.34	877	0.01	2.36	1092	0.01
2-Methylbutyl acetate	2.38	880	0.01	2.34	1090	0.01
Heptanal	2.62	900	tr	3.10	1150	0.01
α-Thujene	2.99	925	0.22	1.41	998	0.22
α-Pinene	3.06	930	1.56	1.35	989	1.57
Camphene	3.25*	942	0.04	1.68	1025	0.03
α-Fenchene	3.25*	942	[0.04]	1.62	1018	0.01
Sabinene	3.67*	970	5.07	2.27	1083	4.69
β-Pinene	3.67*	970	[5.07]	2.08	1064	0.50
6-Methyl-5-hepten-2-one	3.91	986	0.03	5.08	1296	0.03
Methyl 2-hydroxy-3-methylvalerate	3.94	988	0.04			
Myrcene	4.00	992	1.99	2.87	1132	2.02
α-Phellandrene	4.15*	1001	0.13	2.76	1124	0.03
Octanal	4.15*	1001	[0.13]	4.43	1249	0.10
Δ3-Carene	4.22	1006	0.01	2.57	1108	0.01
α-Terpinene	4.33	1013	0.13	2.94	1138	0.14
para-Cymene	4.46	1021	0.14	4.10	1225	0.16
1,8-Cineole	4.58*	1029	32.17	3.34	1169	28.57
Limonene	4.58*	1029	[32.17]	3.18	1156	3.19
(*Z*)-β-Ocimene	4.74	1039	0.04	3.77	1202	0.04
(*E*)-β-Ocimene	4.89	1048	0.10	3.97	1216	0.11
γ-Terpinene	5.01	1056	0.29	3.80	1203	0.29
cis-Sabinene hydrate	5.13	1063	0.40	6.92*	1429	0.43
cis-Linalool oxide (fur.)	5.22	1069	0.03	6.55	1402	0.03
Octanol	5.30	1074	0.06	8.22	1525	0.07
Terpinolene	5.47*	1085	0.16	4.27	1238	0.15
trans-Linalool oxide (fur.)	5.47*	1085	[0.16]	6.92*	1429	[0.43]
para-Cymenene	5.47*	1085	[0.16]	6.34	1387	0.01
6,7-Epoxymyrcene	5.58	1092	0.03	6.09	1370	0.03
trans-Sabinene hydrate	5.62	1094	0.25	7.99	1508	0.26
Linalool	5.73	1102	3.95	8.10†	1517	8.53
(*E*)-4,8-Dimethylnona-1,3,7-	5.98*	1118	0.12	4.77	1274	0.09

triene						
cis-para-Menth-2-en-1-ol	5.98*	1118	[0.12]	8.14*†	1520	[8.53]
cis-para-Mentha-2,8-dien-1-ol	6.24	1134	0.02	9.57	1630	0.02
trans-para-Menth-2-en-1-ol	6.27	1136	0.02	8.99	1584	0.02
Borneol	6.65	1161	0.02	9.82*†	1651	[40.18]
δ-Terpineol	6.68	1163	0.09	9.54	1628	0.09
Terpinen-4-ol	6.84	1173	0.95	8.60	1554	0.95
para-Cymen-8-ol	6.98	1183	0.02	11.58	1797	0.01
α-Terpineol	7.07*	1188	1.34	9.82*†	1651	[40.18]
Myrtenal	7.07*	1188	[1.34]	8.74	1565	0.02
γ-Terpineol	7.15	1194	0.08	9.91*	1657	0.34
Decanal	7.34	1206	0.05	7.30	1457	0.04
Octyl acetate	7.49	1216	0.11	7.08	1441	0.10
cis-Sabinene hydrate acetate?	7.53	1219	0.66	6.86	1425	0.65
cis-Carveol	7.68	1230	0.01	11.77	1813	0.01
Unknown [m/z 43, 71 (64), 68 (54), 81 (49), 93 (34), 121 (33)...]	7.76	1235	0.01	7.87	1499	0.01
Neral	7.83	1240	0.23	9.50	1625	0.30
(2*E*)-Decenal	8.14*	1262	5.44	9.07	1591	0.02
Geraniol	8.14*	1262	[5.44]	11.67*	1805	0.96
Linalyl acetate	8.14*	1262	[5.44]	8.14*†	1520	[8.53]
Geranial	8.29	1272	0.32	10.14	1676	0.32
Bornyl acetate	8.49	1286	0.04	8.25	1528	0.03
Terpinen-4-yl acetate	8.67	1298	0.01	8.77	1568	0.02
Geranyl formate	8.79	1306	0.01	9.91*	1657	[0.34]
δ-Terpinyl acetate	8.96	1313	0.14	9.16	1597	0.14
Methyl geranate	9.10	1323	0.08	9.82*†	1651	[40.18]
δ-Elemene	9.26	1334	0.01	6.92*	1429	[0.43]
α-Terpinyl acetate	9.51	1352	38.78	9.79*†	1648	40.18
Neryl acetate	9.69	1365	0.03	10.20	1681	0.02
α-Copaene	9.79	1372	0.02	7.20	1449	0.02
Methyl (*E*)-cinnamate	9.88	1379	0.01	13.91	2006	0.01
Geranyl acetate	9.97	1384	0.78	10.58	1712	0.81
Dodecenyl acetate isomer?	10.00	1387	0.04			
Dodecenal isomer	10.03*	1389	0.09			
β-Elemene	10.03*	1389	[0.09]	8.40†	1539	0.06
β-Caryophyllene	10.36	1413	0.05	8.42†	1541	[0.06]
α-Terpinyl propionate	10.63	1433	0.07			
Unknown [m/z 43, 109 (35), 96 (23), 93 (22), 137 (21), 81 (20)...204 (5)]	10.82	1447	0.02			

Geranylacetone	10.87	1451	0.01	11.67*	1805	[0.96]
8-Acetoxy-*trans*-para-Menth-2-en-1-ol [2-(4-Hydroxy-4-methylcyclohex-2-enyl)propan-2-yl acetate]	10.91	1454	0.02	15.22	2133	0.03
Germacrene D	11.19	1475	0.06	9.79*†	1648	[40.18]
β-Selinene	11.25*	1479	0.26	9.91*	1657	[0.34]
Geranyl propionate	11.25*	1479	[0.26]	11.37	1778	0.01
α-Selinene	11.38	1489	0.09	9.96*	1662	0.10
δ-Amorphene	11.56	1503	0.02	9.96*	1662	[0.10]
γ-Cadinene	11.64	1508	0.11	10.39	1696	0.12
δ-Cadinene	11.77	1519	0.04	10.45	1701	0.07
Unknown [m/z 109, 43 (43), 137 (19), 95 (18), 119 (17), 93 (17), 108 (14)...]	11.85	1525	tr			
Germacrene B	12.15	1549	0.07	11.11	1757	0.09
(*E*)-Nerolidol	12.34	1564	0.79	13.81	1997	0.81
Dendrolasin	12.46	1574	0.01	12.60	1886	0.02
(3*E*,7*E*)-4,8,12-Trimethyl-1,3,7,11-tridecatetraene	12.55	1580	0.13	11.22	1766	0.10
Unknown [m/z 81, 43 (52), 161 (49), 105 (30), 207 (27), 95 (26), 93 (24), 109 (24)...]	12.96	1614	0.02	15.00	2111	0.02
Unknown [m/z 43, 71 (53), 108 (47), 126 (41), 109 (35), 93 (25)...]	13.11	1626	0.02	19.97	2655	0.01
Unknown [m/z 43, 135 (59), 94 (33), 59 (25), 137 (25), 93 (19)...]	13.35	1645	0.01			
Unknown [m/z 43, 81 (84), 41 (64), 67 (62), 95 (58), 79 (58)... 204 (48), 220 (2)]	13.39	1649	0.01	15.55	2167	0.01
(2*E*,6*Z*)-Farnesal	14.15	1712	0.11			
(2*E*,6*E*)-Farnesol	14.25	1721	0.13	16.86	2302	0.11
(2*E*,6*E*)-Farnesal	14.46	1739	0.05	15.85	2197	0.07
γ-Bicyclohomofarnesal	14.99	1785	0.02	16.78	2293	0.05
(2*E*,6*E*)-Farnesyl acetate	15.62	1842	0.03	15.95	2207	0.04
Coronarin *E*	18.42	2110	0.06	19.80	2634	0.05
Total identified		**98.55%**			**98.22%**	

Total reported	**98.63%**	**98.26%**

*: 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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