

**Date :** December 03, 2018

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 18K30-PTH01-1-CC

**Customer identification :** Cardamom - Guatemala - CA310487R

**Type :** Essential oil

**Source :** *Elettaria cardamomum*

**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 :** Sylvain Mercier, M. Sc., Chimiste

**Analysis date :** November 30, 2018

Checked and approved by :

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

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PHYSICOCHEMICAL DATA

**Physical aspect:** Clear liquid

**Refractive index:** 1.4625 ± 0.0003 (20 °C)

ISO 4733:2004 - OIL OF CARDAMOM - CENTRAL AMERICA

Compound	Min. %	Max. %	Observed %	Complies?
(E)-Nerolidol	0.5	1.0	0.9	Yes
α-Terpinyl acetate	35	45	39	Yes
α-Terpineol	tr	2.50	1.34	Yes
Terpinen-4-ol	0.8	1.5	0.5	No
Linalyl acetate	4	6	5.7	Yes
Linalool	3	6	3	Yes
1,8-Cineole	27	35	29.6	Yes
Limonene	2.0	3.0	2.3	Yes
Myrcene	tr	2.50	2.25	Yes
Sabinene	3	5	4	Yes
α-Pinene	1.0	2.0	1.6	Yes
<b>Refractive index</b>	1.4600	1.4670	1.4625	Yes

CONCLUSION

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
Isobutyral	tr	0.01	Aliphatic aldehyde
Isovaleral	0.02	0.02	Aliphatic aldehyde
2-Methylbutyral	0.01	0.01	Aliphatic aldehyde
Isoamyl alcohol	0.01	0.02	Aliphatic alcohol
2-Methylbutanol	0.01	0.01	Aliphatic alcohol
Hexanal	0.01	0.01	Aliphatic aldehyde
Hexanol	tr	0.01	Aliphatic alcohol
Isoamyl acetate	0.01	0.01	Aliphatic ester
2-Methylbutyl acetate	0.01	tr	Aliphatic ester
$\alpha$ -Thujene	0.23	0.22	Monoterpene
$\alpha$ -Pinene	1.62	1.58	Monoterpene
Camphene	0.04*	0.03	Monoterpene
$\alpha$ -Fenchene	[0.04]*	0.01	Monoterpene
$\beta$ -Pinene	4.93*	0.38	Monoterpene
Sabinene	[4.93]*	4.42	Monoterpene
6-Methyl-5-hepten-2-one	0.04	0.03	Aliphatic ketone
Myrcene	2.25	2.19	Monoterpene
$\alpha$ -Phellandrene	0.15*	0.02	Monoterpene
Octanal	[0.15]*	0.13	Aliphatic aldehyde
$\Delta^3$ -Carene	0.02	0.01	Monoterpene
$\alpha$ -Terpinene	0.10	0.10	Monoterpene
para-Cymene	0.06	0.07	Monoterpene
Limonene	31.79*	2.29	Monoterpene
$\beta$ -Phellandrene	[31.79]*	29.56*	Monoterpene
1,8-Cineole	[31.79]*	[29.56]*	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.03	0.03	Monoterpene
(E)- $\beta$ -Ocimene	0.06	0.06	Monoterpene
$\gamma$ -Terpinene	0.23	0.22	Monoterpene
cis-Sabinene hydrate	0.44	0.42	Monoterpenic alcohol
cis-Linalool oxide (fur.)	tr	0.01	Monoterpenic alcohol
Octanol	0.06	0.07	Aliphatic alcohol
Terpinolene	0.10	0.10	Monoterpene
6,7-Epoxymyrcene	0.04	0.03	Monoterpenic ether
trans-Sabinene hydrate	0.26	0.27	Monoterpenic alcohol
Linalool	3.43	3.41	Monoterpenic alcohol
(E)-4,8-Dimethylnona-1,3,7-triene	0.14*	0.10	Terpene derivative
cis-para-Menth-2-en-1-ol	[0.14]*	5.72*	Monoterpenic alcohol
trans-para-Menth-2-en-1-ol	0.01	0.01	Monoterpenic alcohol
$\delta$ -Terpineol	0.09	0.34*	Monoterpenic alcohol
Terpinen-4-ol	0.56	0.55	Monoterpenic alcohol
para-Cymen-8-ol	0.03	0.01	Monoterpenic alcohol
$\alpha$ -Terpineol	1.36*	40.55*	Monoterpenic alcohol
cis-Piperitol	[1.36]*	0.02	Monoterpenic alcohol
$\gamma$ -Terpineol	0.09	[40.55]*	Monoterpenic alcohol
trans-Piperitol	0.04	[0.21]*	Monoterpenic alcohol
Octyl acetate	0.10	0.10	Aliphatic ester
Unknown	0.86	0.98*	Monoterpenic ester
Unknown	0.01	0.01	Unknown

Neral	0.27	[0.34]*	Monoterpenic aldehyde
Geraniol	6.71*	[0.98]*	Monoterpenic alcohol
Linalyl acetate	[6.71]*	[5.72]*	Monoterpenic ester
Geranial	0.36	0.36	Monoterpenic aldehyde
Bornyl acetate	0.03	0.04	Monoterpenic ester
Terpinen-4-yl acetate	0.01	0.02	Monoterpenic ester
$\delta$ -Terpinyl acetate	0.14	0.15	Monoterpenic ester
Methyl geranate	0.08	[40.55]*	Monoterpenic ester
$\delta$ -Elemene	0.01	0.02	Sesquiterpene
$\alpha$ -Terpinyl acetate	39.12*	[40.55]*	Monoterpenic ester
$\gamma$ -Terpinyl acetate	[39.12]*	[40.55]*	Monoterpenic ester
Neryl acetate	0.01	0.01	Monoterpenic ester
$\alpha$ -Copaene	0.02	0.01	Sesquiterpene
Geranyl acetate	0.76	0.76	Monoterpenic ester
$\beta$ -Elemene	0.11*	0.07*	Sesquiterpene
Dodecenylyl acetate isomer?	[0.11]*		Aliphatic ester
$\beta$ -Caryophyllene	0.05	[0.07]*	Sesquiterpene
$\alpha$ -Terpinyl propionate	0.06		Monoterpenic ester
$\alpha$ -Humulene	0.02	0.01	Sesquiterpene
Germacrene D	0.09*	[40.55]*	Sesquiterpene
Geranyl propionate	[0.09]*	0.02	Monoterpenic ester
$\beta$ -Selinene	0.34	0.40	Sesquiterpene
$\alpha$ -Selinene	0.12	0.14	Sesquiterpene
$\gamma$ -Cadinene	0.14	0.21	Sesquiterpene
$\delta$ -Cadinene	0.03	[0.21]*	Sesquiterpene
Germacrene B	0.08	0.08	Sesquiterpene
( <i>E</i> )-Nerolidol	0.87	0.88	Sesquiterpenic alcohol
Dendrolasin	0.01	0.02	Sesquiterpenic ether
(3 <i>E</i> ,7 <i>E</i> )-4,8,12-Trimethyl-1,3,7,11-tridecatetraene	0.20	0.18	Terpene derivative
Unknown	0.02	0.02	Oxygenated sesquiterpene
(2 <i>E</i> ,6 <i>Z</i> )-Farnesal	0.03		Sesquiterpenic aldehyde
(2 <i>E</i> ,6 <i>E</i> )-Farnesol	0.07	0.08	Sesquiterpenic alcohol
(2 <i>E</i> ,6 <i>E</i> )-Farnesal	0.04	0.05	Sesquiterpenic aldehyde
$\gamma$ -Bicyclohomofarnesal	0.02		Terpenic aldehyde
(2 <i>E</i> ,6 <i>E</i> )-Farnesyl acetate	0.03	0.03	Sesquiterpenic ester
Coronarín <i>E</i>	0.05	0.05	Diterpene
<b>Total identified</b>	<b>98.25%</b>	<b>97.72%</b>	

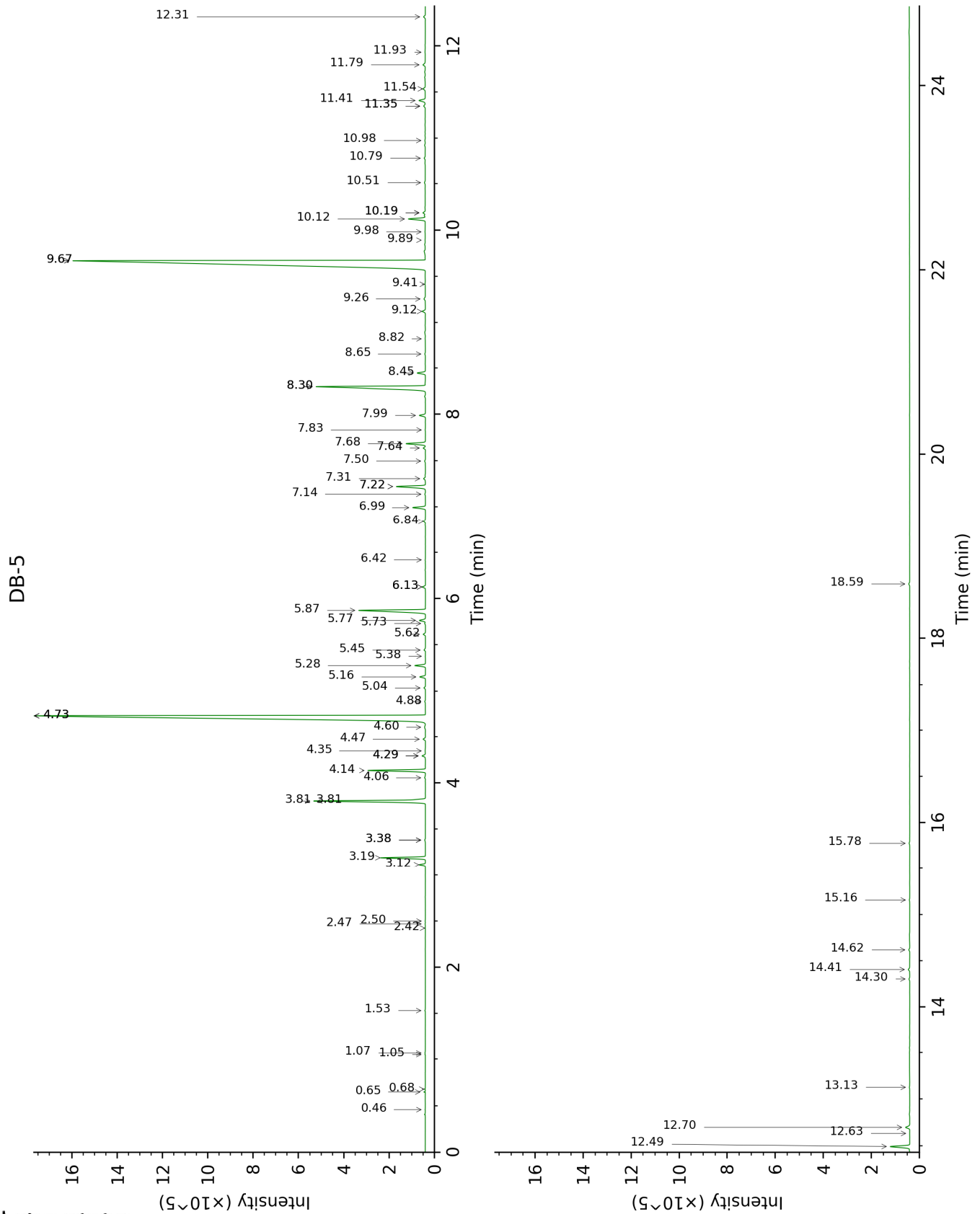
\*: Two or more compounds are coeluting on this column

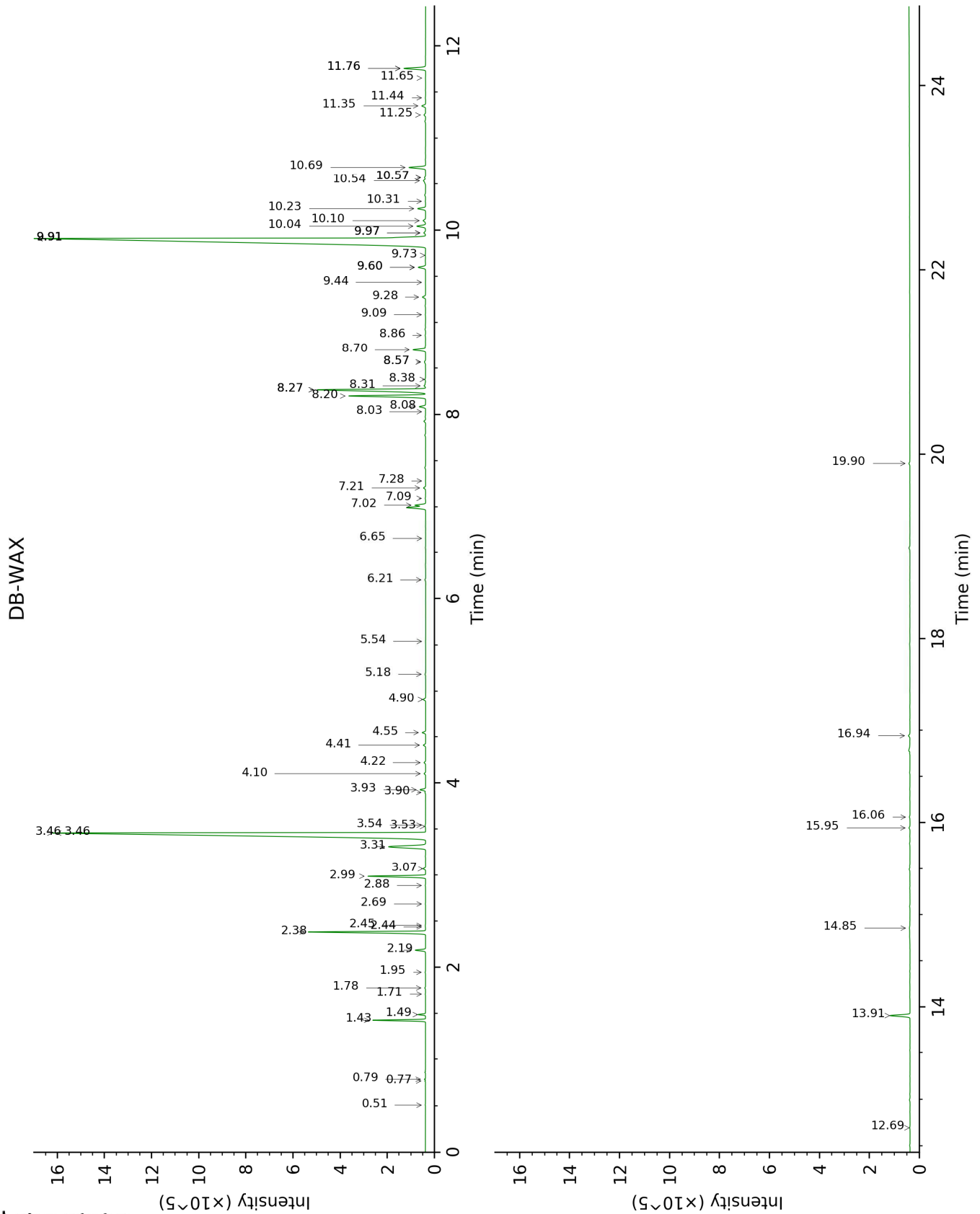
[xx]: Duplicate percentage due to coelutions, not taken account in the identified total

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	%
Isobutylal	0.46	554	tr	0.51	780	0.01
Isovaleral	0.65	641	0.02	0.79	888	0.02
2-Methylbutylal	0.68	650	0.01	0.77	882	0.01
Isoamyl alcohol	1.05	732	0.01	3.54	1178	0.02
2-Methylbutanol	1.07	734	0.01	3.53	1177	0.01
Hexanal	1.53	797	0.01	1.95	1044	0.01
Hexanol	2.42	873	tr	5.54	1322	0.01
Isoamyl acetate	2.47	876	0.01	2.45	1092	0.01
2-Methylbutyl acetate	2.50	879	0.01	2.44	1090	tr
$\alpha$ -Thujene	3.12	924	0.23	1.49	1001	0.22
$\alpha$ -Pinene	3.19	929	1.62	1.43	992	1.58
Camphene	3.38*	942	0.04	1.78	1028	0.03
$\alpha$ -Fenchene	3.38*	942	[0.04]	1.71	1022	0.01
$\beta$ -Pinene	3.81*	969	4.93	2.19	1066	0.38
Sabinene	3.81*	969	[4.93]	2.38	1085	4.42
6-Methyl-5-hepten-2-one	4.06	986	0.04	5.18	1297	0.03
Myrcene	4.14	991	2.25	2.99	1134	2.19
$\alpha$ -Phellandrene	4.29*	1002	0.15	2.88	1126	0.02
Octanal	4.29*	1002	[0.15]	4.55	1254	0.13
$\Delta^3$ -Carene	4.35	1005	0.02	2.68	1111	0.01
$\alpha$ -Terpinene	4.47	1013	0.10	3.07	1140	0.10
para-Cymene	4.60	1021	0.06	4.22	1230	0.07
Limonene	4.73*	1029	31.79	3.31	1160	2.29
$\beta$ -Phellandrene	4.73*	1029	[31.79]	3.46*	1171	29.56
1,8-Cineole	4.73*	1029	[31.79]	3.46*	1171	[29.56]
(Z)- $\beta$ -Ocimene	4.88	1038	0.03	3.90	1206	0.03
(E)- $\beta$ -Ocimene	5.04	1048	0.06	4.10	1221	0.06
$\gamma$ -Terpinene	5.16	1056	0.23	3.93	1208	0.22
cis-Sabinene hydrate	5.28	1064	0.44	7.02	1429	0.42
cis-Linalool oxide (fur.)	5.38	1070	tr	6.65	1402	0.01
Octanol	5.44	1074	0.06	8.31	1526	0.07
Terpinolene	5.62	1085	0.10	4.41	1244	0.10
6,7-Epoxyterpinene	5.73	1092	0.04	6.20	1370	0.03
trans-Sabinene hydrate	5.77	1094	0.26	8.08	1508	0.27
Linalool	5.87	1101	3.43	8.20	1517	3.41
(E)-4,8-Dimethylnona-1,3,7-triene	6.13*	1118	0.14	4.90	1282	0.10
cis-para-Menth-2-en-1-ol	6.13*	1118	[0.14]	8.27*	1523	5.72
trans-para-Menth-2-en-1-ol	6.42	1136	0.01	9.09	1586	0.01
$\delta$ -Terpineol	6.84	1164	0.09	9.60*	1627	0.34
Terpinen-4-ol	6.99	1174	0.56	8.70	1556	0.55



para-Cymen-8-ol	7.14	1183	0.03	11.65	1797	0.01
$\alpha$ -Terpineol	7.22*	1189	1.36	9.91*†	1652	40.55
cis-Piperitol	7.22*	1189	[1.36]	9.73	1637	0.02
$\gamma$ -Terpineol	7.31	1194	0.09	9.97*†	1657	[40.55]
trans-Piperitol	7.50	1207	0.04	10.57*†	1706	[0.21]
Octyl acetate	7.64	1216	0.10	7.21	1443	0.10
Unknown [m/z 93, 121 (69), 43 (60), 136 (46), 81 (25)...	7.68	1220	0.86	11.76*	1806	0.98
Unknown [m/z 43, 71 (64), 68 (54), 81 (49), 93 (34), 121 (33)...	7.83	1230	0.01	8.03	1504	0.01
Neral	7.99	1240	0.27	9.60*	1627	[0.34]
Geraniol	8.30*	1262	6.71	11.76*	1806	[0.98]
Linalyl acetate	8.30*	1262	[6.71]	8.27*	1523	[5.72]
Geranial	8.45	1272	0.36	10.23	1678	0.36
Bornyl acetate	8.65	1286	0.03	8.38	1531	0.04
Terpinen-4-yl acetate	8.82	1298	0.01	8.86	1568	0.02
$\delta$ -Terpinyl acetate	9.12	1312	0.14	9.28	1601	0.15
Methyl geranate	9.26	1322	0.08	9.91*†	1652	[40.55]
$\delta$ -Elemene	9.42	1333	0.01	7.09	1435	0.02
$\alpha$ -Terpinyl acetate	9.67*	1351	39.12	9.91*†	1652	[40.55]
$\gamma$ -Terpinyl acetate	9.67*	1351	[39.12]	9.91*†	1652	[40.55]
Neryl acetate	9.89	1367	0.01	10.31	1684	0.01
$\alpha$ -Copaene	9.98	1374	0.02	7.28	1449	0.01
Geranyl acetate	10.12	1384	0.76	10.68	1715	0.76
$\beta$ -Elemene	10.19*	1388	0.11	8.57*	1546	0.07
Dodecanyl acetate isomer?	10.19*	1388	[0.11]			
$\beta$ -Caryophyllene	10.51	1412	0.05	8.57*	1546	[0.07]
$\alpha$ -Terpinyl propionate	10.78	1432	0.06			
$\alpha$ -Humulene	10.98	1447	0.02	9.44	1614	0.01
Germacrene D	11.35*	1475	0.09	9.97*†	1657	[40.55]
Geranyl propionate	11.35*	1475	[0.09]	11.44	1779	0.02
$\beta$ -Selinene	11.41	1480	0.34	10.04	1662	0.40
$\alpha$ -Selinene	11.54	1489	0.12	10.10	1667	0.14
$\gamma$ -Cadinene	11.80	1509	0.14	10.54†	1703	0.21
$\delta$ -Cadinene	11.93	1519	0.03	10.57*†	1706	[0.21]
Germacrene B	12.31	1550	0.08	11.25	1763	0.08
(E)-Nerolidol	12.49	1564	0.87	13.91	2001	0.88
Dendrolasin	12.63	1575	0.01	12.69	1889	0.02
(3E,7E)-4,8,12-Trimethyl-1,3,7,11-tridecatetraene	12.70	1580	0.20	11.35	1772	0.18
Unknown [m/z 161, 43 (74), 105 (57), 121 (45), 81 (43) ... 204 (31) ...]	13.13	1615	0.02	14.85	2092	0.02
(2E,6Z)-Farnesal	14.30	1713	0.03			

(2E,6E)-Farnesol	14.41	1722	0.07	16.94	2305	0.08
(2E,6E)-Farnesal	14.62	1740	0.04	15.94	2201	0.05
Y-Bicyclohomofarnesal	15.16	1787	0.02			
(2E,6E)-Farnesyl acetate	15.78	1843	0.03	16.06	2213	0.03
Coronarín E	18.59	2113	0.05	19.90	2639	0.05
<b>Total identified</b>		<b>98.25%</b>			<b>97.72%</b>	
<b>Total reported</b>		<b>99.15%</b>			<b>97.75%</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