

**Date :** June 21, 2023

**CERTIFICATE OF ANALYSIS – GC PROFILING**

*SAMPLE IDENTIFICATION*

**Internal code :** 23F15-PTH01


**Customer identification :** Cardamom - Guatemala - CA3109R

**Type :** Essential oil

**Source :** *Elettaria cardamomum*

**Customer :** Plant Therapy

*ANALYSIS*

**Method:** PC-MAT-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 :** Amélie Simard, Analyste

**Analysis date :** June 19, 2023

Checked and approved by :

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

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*PHYSICOCHEMICAL DATA*

**Physical aspect:** Faintly yellow liquid

**Refractive index:**  $1.4635 \pm 0.0003$  (20 °C; method PC-MAT-016)

*CONCLUSION*

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

## ANALYSIS SUMMARY – CONSOLIDATED CONTENTS

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

Identification	%	Class
Isovaleral	0.01	Aliphatic aldehyde
2-Methylbutyral	0.01	Aliphatic aldehyde
2-Ethylfuran	tr	Furan
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	tr	Aliphatic ester
Heptanal	0.01	Aliphatic aldehyde
Tricyclene	0.01	Monoterpene
$\alpha$ -Thujene	0.24	Monoterpene
$\alpha$ -Pinene	1.80	Monoterpene
$\alpha$ -Fenchene	0.01	Monoterpene
Camphene	0.03	Monoterpene
$\beta$ -Pinene	0.46	Monoterpene
Sabinene	4.90	Monoterpene
6-Methyl-5-hepten-2-one	0.04	Aliphatic ketone
Methyl 2-hydroxy-3-methylvalerate	0.01	Aliphatic ester
Myrcene	2.22	Monoterpene
Octanal	0.16	Aliphatic aldehyde
$\alpha$ -Phellandrene	0.02	Monoterpene
$\Delta^3$ -Carene	0.02	Monoterpene
$\alpha$ -Terpinene	0.11	Monoterpene
para-Cymene	0.19	Monoterpene
Limonene	2.50	Monoterpene
1,8-Cineole	29.47	Monoterpenic ether
(Z)- $\beta$ -Ocimene	0.04	Monoterpene
(E)- $\beta$ -Ocimene	0.07	Monoterpene
$\gamma$ -Terpinene	0.27	Monoterpene
cis-Sabinene hydrate	0.53	Monoterpenic alcohol
cis-Linalool oxide (fur.)	0.02	Monoterpenic alcohol
Octanol	0.05	Aliphatic alcohol
Terpinolene	0.12	Monoterpene
6,7-Epoxymyrcene	0.06	Monoterpenic ether
trans-Sabinene hydrate	0.31	Monoterpenic alcohol
Linalool	3.62	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.14	Monoterpenic alcohol
cis-Limonene oxide	0.03	Monoterpenic ether
trans-para-Menth-2-en-1-ol	0.03	Monoterpenic alcohol
Unknown	0.01	Oxygenated monoterpene
Borneol	0.02	Monoterpenic alcohol
$\delta$ -Terpineol	0.12	Monoterpenic alcohol
Terpinen-4-ol	0.81	Monoterpenic alcohol
para-Cymen-8-ol	0.03	Monoterpenic alcohol

α-Terpineol	1.86	Monoterpenic alcohol
Myrtenal	0.01	Monoterpenic aldehyde
γ-Terpineol	0.07	Monoterpenic alcohol
cis-Piperitol	0.02	Monoterpenic alcohol
Decanal	0.04	Aliphatic aldehyde
trans-Piperitol	0.03	Monoterpenic alcohol
Octyl acetate	0.06	Aliphatic ester
cis-Sabinene hydrate acetate?	0.29	Monoterpenic ester
trans-Carveol	0.01	Monoterpenic alcohol
exo-2-Hydroxycineole	0.01	Monoterpenic alcohol
cis-Carveol	0.02	Monoterpenic alcohol
Unknown	0.01	Unknown
Neral	0.38	Monoterpenic aldehyde
Geraniol	0.79	Monoterpenic alcohol
Linalyl acetate	5.63	Monoterpenic ester
(2E)-Decenal	0.06	Aliphatic aldehyde
Geranial	0.54	Monoterpenic aldehyde
Bornyl acetate	0.03	Monoterpenic ester
2-Undecanone	0.03	Aliphatic ketone
Terpinen-4-yl acetate	0.03	Monoterpenic ester
Geranyl formate	0.02	Monoterpenic ester
δ-Terpinyl acetate	0.15	Monoterpenic ester
Methyl geranate	0.07	Monoterpenic ester
δ-Elemene	0.02	Sesquiterpene
α-Terpinyl acetate	37.25	Monoterpenic ester
Eugenol	0.03	Phenylpropanoid
Neryl acetate	0.02	Monoterpenic ester
α-Copaene	0.01	Sesquiterpene
Geranyl acetate	0.39	Monoterpenic ester
Dodeceny acetate isomer?	0.06	Aliphatic ester
β-Elemene	0.07	Sesquiterpene
β-Caryophyllene	0.04	Sesquiterpene
α-Terpinyl propionate	0.08	Monoterpenic ester
Unknown	0.04	Sesquiterpene
α-Humulene	0.01	Sesquiterpene
Geranylacetone	0.02	Monoterpenic ketone
8-Acetoxy-trans-para-Menth-2-en-1-ol [2-(4-Hydroxy-4-methylcyclohex-2-enyl)propan-2-yl acetate]	0.03	Monoterpenic ester
Germacrene D	0.05	Sesquiterpene
Geranyl propionate	0.02	Monoterpenic ester
β-Selinene	0.29	Sesquiterpene
α-Selinene	0.10	Sesquiterpene
γ-Cadinene	0.12	Sesquiterpene
δ-Cadinene	0.04	Sesquiterpene
Unknown	0.02	Unknown
Germacrene B	0.06	Sesquiterpene
(E)-Nerolidol	0.83	Sesquiterpenic alcohol
Dendrolasin	0.02	Sesquiterpenic ether
(3E,7E)-4,8,12-Trimethyl-1,3,7,11-tridecatetraene	0.17	Terpene derivative
Unknown	0.02	Oxygenated sesquiterpene

Unknown	0.02	Unknown
Unknown	0.01	Unknown
Unknown	0.03	Oxygenated sesquiterpene
(2E,6Z)-Farnesal	0.05	Sesquiterpenic aldehyde
(2E,6E)-Farnesol	0.09	Sesquiterpenic alcohol
(2E,6E)-Farnesal	0.06	Sesquiterpenic aldehyde
γ-Bicyclohomofarnesal	0.04	Terpenic aldehyde
(2E,6E)-Farnesyl acetate	0.03	Sesquiterpenic ester
Coronarín E	0.12	Diterpene
<b>Consolidated total</b>	<b>98.92%</b>	

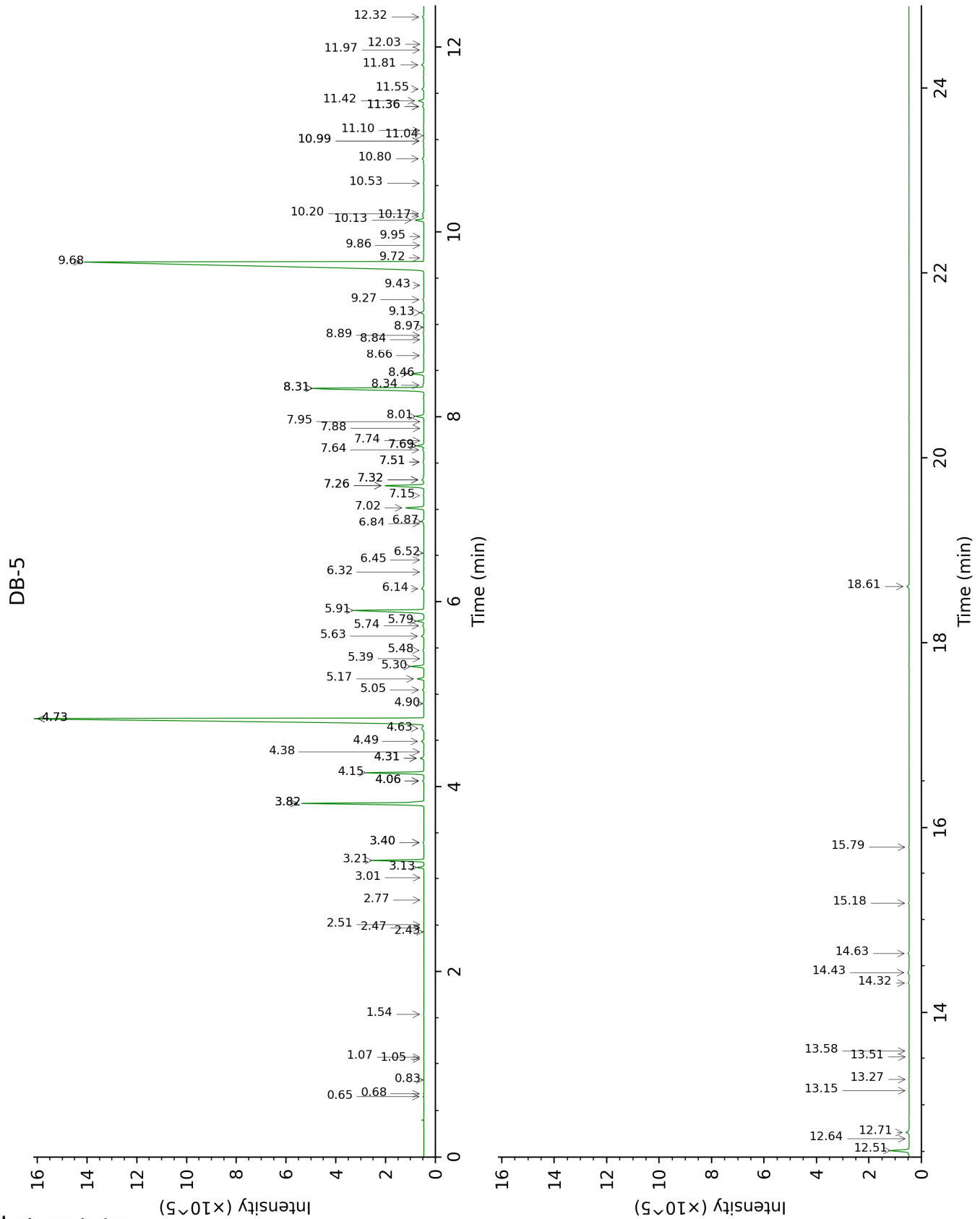
tr: The compound has been detected below 0.005% of total signal.

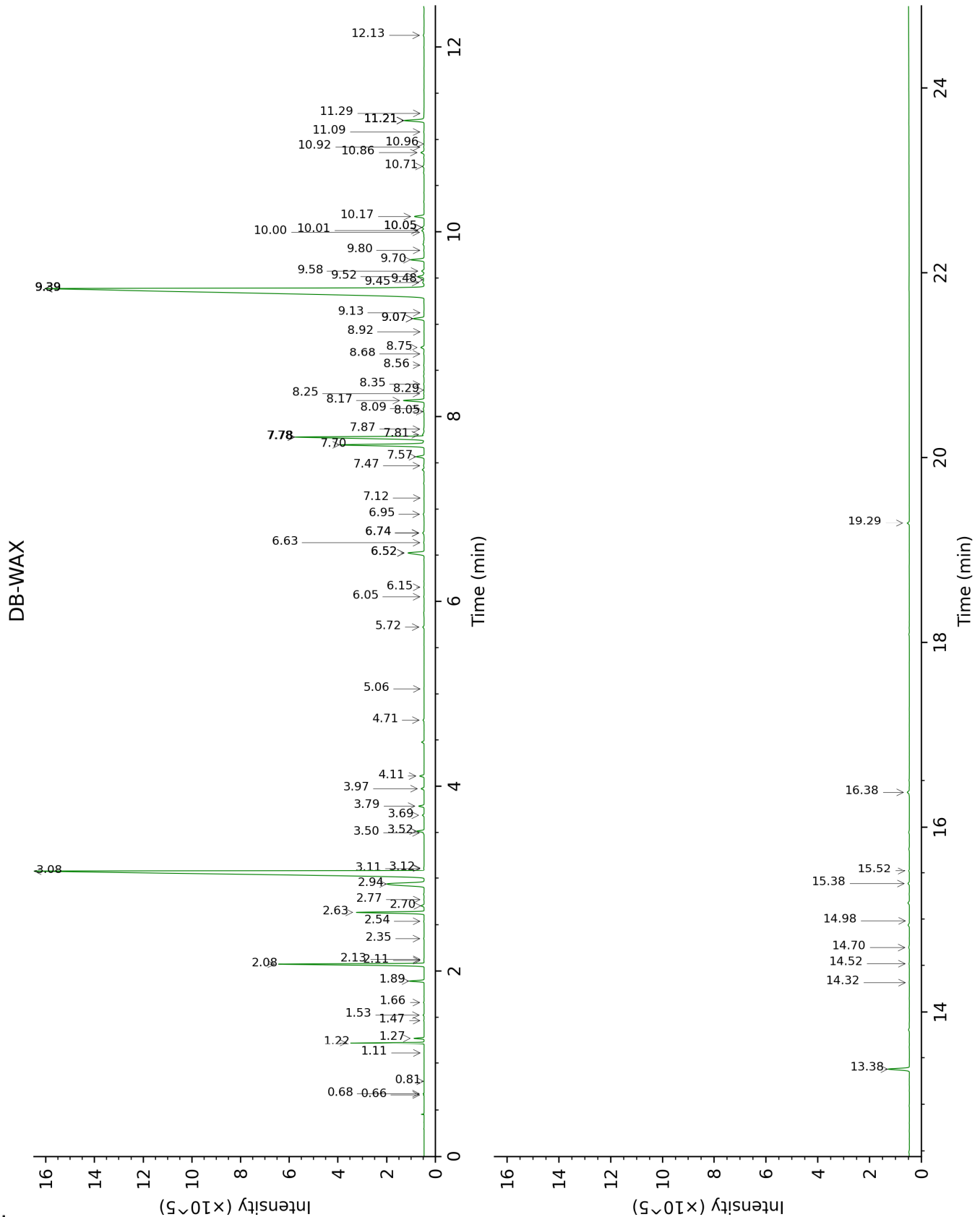
Note: no correction factor was applied

**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.

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







FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
Isovaleral	0.65	641	0.01	0.68	888	0.01
2-Methylbutyral	0.68	651	0.01	0.66	882	0.01
2-Ethylfuran	0.83	700	tr	0.81	922	tr
Isoamyl alcohol	1.05	733	0.01	3.12	1176	0.01
2-Methylbutanol	1.07	736	0.01	3.11	1175	0.01
Hexanal	1.54	800	0.01	1.66	1044	0.01
Hexanol	2.43	874	0.01	5.06	1321	0.01
Isoamyl acetate	2.47	878	0.01	2.13	1092	0.01
2-Methylbutyl acetate	2.51	881	tr	2.11	1091	0.01
Heptanal	2.77	902	0.01	2.77	1147	0.01
Tricyclene	3.01	918	0.01	1.11	975	tr
$\alpha$ -Thujene	3.13	926	0.24	1.28	1003	0.24
$\alpha$ -Pinene	3.20	931	1.80	1.22	994	1.81
$\alpha$ -Fenchene	3.40*	944	0.05	1.47	1024	0.01
Camphene	3.40*	944	[0.05]	1.53	1030	0.03
$\beta$ -Pinene	3.82*	972	5.30	1.89	1068	0.46
Sabinene	3.82*	972	[5.30]	2.08	1086	4.90
6-Methyl-5-hepten-2-one	4.06*	988	0.07	4.71	1301	0.04
Methyl 2-hydroxy-3-methylvalerate	4.06*	988	[0.07]	7.12	1474	0.01
Myrcene	4.15	993	2.22	2.63	1136	2.25
Octanal	4.31*	1004	0.18	4.11	1254	0.16
$\alpha$ -Phellandrene	4.31*	1004	[0.18]	2.54	1128	0.02
$\Delta$ 3-Carene	4.38	1008	0.02	2.35	1113	0.02
$\alpha$ -Terpinene	4.49	1015	0.11	2.70	1142	0.11
para-Cymene	4.63	1024	0.19	3.79	1229	0.19
Limonene	4.73*	1030	31.89	2.94	1161	2.50
1,8-Cineole	4.73*	1030	[31.89]	3.08	1172	29.47
(Z)- $\beta$ -Ocimene	4.90	1040	0.04	3.50	1207	0.02
(E)- $\beta$ -Ocimene	5.05	1050	0.07	3.69	1222	0.07
$\gamma$ -Terpinene	5.17	1058	0.27	3.52	1209	0.26
cis-Sabinene hydrate	5.30	1066	0.53	6.52*	1429	0.82
cis-Linalool oxide (fur.)	5.39	1071	0.02	6.15	1401	0.02
Octanol	5.48	1077	0.05	7.81	1526	0.07
Terpinolene	5.63	1086	0.12	3.97	1244	0.11
6,7-Epoxyterpinene	5.74	1093	0.06	5.72	1370	0.05
trans-Sabinene hydrate	5.79	1096	0.31	7.57	1507	0.30
Linalool	5.91	1104	3.62	7.70	1517	3.64
cis-para-Menth-2-en-1-ol	6.14	1118	0.14	7.78*	1524	5.76
cis-Limonene oxide	6.32	1130	0.03	6.05	1394	0.02
trans-para-Menth-2-en-1-ol	6.45	1138	0.03	8.56	1585	0.02

Unknown [m/z 109, 43 (73), 71 (54), 124 (51), 69 (37), 41 (35)...152 (5)]	6.52	1143	0.01			
Borneol	6.84	1163	0.02	9.39*	1652	39.39
δ-Terpineol	6.87	1165	0.12	9.07*	1626	0.46
Terpinen-4-ol	7.02	1175	0.81	8.17	1555	0.80
para-Cymen-8-ol	7.15	1183	0.03	11.08	1796	0.02
α-Terpineol	7.26*	1190	1.87	9.39*	1652	[39.39]
Myrtenal	7.26*	1190	[1.87]	8.29	1564	0.01
γ-Terpineol	7.32*	1194	0.11	9.45	1658	0.07
cis-Piperitol	7.32*	1194	[0.11]	9.13	1631	0.02
Decanal	7.51*	1206	0.05	6.95	1461	0.04
trans-Piperitol	7.51*	1206	[0.05]	10.00	1702	0.03
Octyl acetate	7.64	1215	0.06	6.74*	1445	0.07
cis-Sabinene hydrate acetate?	7.69*	1218	0.30	6.52*	1429	[0.82]
trans-Carveol	7.69*	1218	[0.30]	10.96	1785	0.01
exo-2-Hydroxycineole	7.74	1221	0.01	11.21*	1807	0.83
cis-Carveol	7.88	1230	0.02	11.29	1814	0.01
Unknown [m/z 43, 71 (64), 68 (54), 81 (49), 93 (34), 121 (33)...]	7.95	1235	0.01	7.47	1500	0.03
Neral	8.01	1239	0.38	9.07*	1626	[0.46]
Geraniol	8.31*	1259	6.46	11.21*	1807	[0.83]
Linalyl acetate	8.31*	1259	[6.46]	7.78*	1524	[5.76]
(2E)-Decenal	8.34	1261	0.06	8.68	1594	0.03
Geranial	8.46	1270	0.54	9.70	1678	0.54
Bornyl acetate	8.66	1283	0.03	7.87	1531	0.03
2-Undecanone	8.84	1295	0.03	8.25	1561	0.02
Terpinen-4-yl acetate	8.89	1298	0.03	8.35	1569	0.02
Geranyl formate	8.97	1304	0.02	9.48	1660	0.02
δ-Terpinyl acetate	9.13	1314	0.15	8.75	1600	0.14
Methyl geranate	9.27	1324	0.07	9.39*	1652	[39.39]
δ-Elementene	9.42	1335	0.02	6.63	1437	0.02
α-Terpinyl acetate	9.68	1353	37.25	9.39*	1652	[39.39]
Eugenol	9.72	1356	0.03	14.32	2099	0.01
Neryl acetate	9.86	1366	0.02	9.80	1686	0.02
α-Copaene	9.95	1372	0.01	6.74*	1445	[0.07]
Geranyl acetate	10.13	1385	0.39	10.17	1717	0.40
Dodecenyl acetate isomer?	10.17	1388	0.06			
β-Elementene	10.20	1390	0.07	8.09	1548	0.04
β-Caryophyllene	10.52	1413	0.04	8.06	1546	0.02
α-Terpinyl propionate	10.80	1433	0.08	10.05*	1707	0.08
Unknown [m/z 43, 109 (35), 96 (23), 93	10.99*	1448	0.05			

(22), 137 (21), 81 (20)...204 (5)]						
α-Humulene	10.99*	1448	[0.05]	8.92	1614	0.01
Geranylacetone	11.04	1452	0.02	11.21*	1807	[0.83]
8-Acetoxy-trans- para-Menth-2-en-1- ol [2-(4-Hydroxy-4- methylcyclohex-2- enyl)propan-2-yl acetate]	11.10	1456	0.03	14.70	2137	0.03
Germacrene D	11.36*	1475	0.07	9.39*	1652	[39.39]
Geranyl propionate	11.36*	1475	[0.07]	10.92	1782	0.02
β-Selinene	11.42	1480	0.29	9.52	1663	0.28
α-Selinene	11.55	1489	0.10	9.58	1668	0.10
γ-Cadinene	11.81	1509	0.12	10.01	1704	0.10
δ-Cadinene	11.97	1521	0.04	10.05*	1707	[0.08]
Unknown [m/z 109, 43 (43), 137 (19), 95 (18), 119 (17), 93 (17), 108 (14)...]	12.03	1526	0.02			
Germacrene B	12.32	1549	0.06	10.71	1764	0.06
(E)-Nerolidol	12.51	1564	0.83	13.38	2007	0.83
Dendrolasin	12.64	1574	0.02	12.13	1890	0.04
(3E,7E)-4,8,12- Trimethyl-1,3,7,11- tridecatetraene	12.71	1579	0.17	10.86	1777	0.14
Unknown [m/z 81, 43 (52), 161 (49), 105 (30), 207 (27), 95 (26), 93 (24), 109 (24)...]	13.15	1615	0.02	14.52	2119	0.02
Unknown [m/z 43, 71 (53), 108 (47), 126 (41), 109 (35), 93 (25)...]	13.27	1625	0.02			
Unknown [m/z 43, 135 (59), 94 (33), 59 (25), 137 (25), 93 (19)...]	13.51	1645	0.01			
Unknown [m/z 43, 81 (84), 41 (64), 67 (62), 95 (58), 79 (58)... 204 (48), 220 (2)]	13.58	1650	0.03	14.98	2166	0.01
(2E,6Z)-Farnesal	14.32	1711	0.05			
(2E,6E)-Farnesol	14.43	1721	0.09	16.38	2314	0.11
(2E,6E)-Farnesal	14.64	1739	0.06	15.38	2208	0.06
γ- Bicyclohomofarnesal	15.18	1786	0.04			
(2E,6E)-Farnesyl acetate	15.79	1840	0.03	15.52	2222	0.03
Coronarín E	18.61	2110	0.12	19.29	2652	0.11

<b>Total identified</b>	<b>98.76%</b>	<b>98.57%</b>
<b>Total reported</b>	<b>98.87%</b>	<b>98.62%</b>

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

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

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