

**Date :** February 18, 2020

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 20B14-PSC01

**Customer identification :** Tea Tree - Zambia - 02102020

**Type :** Essential oil

**Source :** *Melaleuca alternifolia* ct. Terpinen-4-ol

**Customer :** Pacha Soap Co.

**ANALYSIS**

**Method:** PC-MAT-007 - Analysis of the composition of an essential oil or other volatile liquide by FAST GC-FID (in French); identifications validated by GC-MS.

**Analyst :** Benoit Roger, Ph. D.

**Analysis date :** February 17, 2020

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:** 1.4771 ± 0.0003 (20 °C)

**Optical rotation:** 7.87°

#### ISO 4730:2017 - TEA TREE OIL

Compound	Min. %	Max. %	Observed %	Complies?
Viridiflorol	tr	1.0	0.1	Yes
Globulol	tr	1.0	0.1	Yes
δ-Cadinene	0.2	3.0	0.6	Yes
Viridiflorene	0.1	3.0	0.7	Yes
Aromadendrene	0.2	3.0	1.0	Yes
α-Terpineol	2.0	5.0	1.8	No
Terpinen-4-ol	35.0	48.0	33.2	No
Terpinolene	1.5	5.0	4.4	Yes
γ-Terpinene	14.0	28.0	23.8	Yes
1,8-Cineole	tr	10.0	5.6	Yes
para-Cymene	0.5	8.0	2.1	Yes
Limonene	0.5	1.5	1.3	Yes
α-Terpinene	6.0	12.0	11.9	Yes
Sabinene	tr	3.5	0.6	Yes
α-Pinene	1.0	4.0	2.8	Yes
<b>Optical rotation</b>	+7.0°	+12.0°	+7.9°	Yes
<b>Refractive index</b>	1.4750	1.4820	1.4771	Yes

#### CONCLUSION

No adulterant, contaminant or diluent has been detected using this method. The oil however fails to comply with the ISO standard for tea tree oil due to low terpinen-4-ol and terpineol contents.

## ANALYSIS SUMMARY – CONSOLIDATED CONTENTS

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

Identification	%	Classe
Ethanol	0.07	Aliphatic alcohol
Isobutyral	tr	Aliphatic aldehyde
Isobutanol	tr	Aliphatic alcohol
Isovaleral	tr	Aliphatic aldehyde
2-Methylbutyral	0.01	Aliphatic aldehyde
(3Z)-Hexenol	0.01	Aliphatic alcohol
$\alpha$ -Thujene	1.11	Monoterpene
$\alpha$ -Pinene	2.83	Monoterpene
Camphene	0.01	Monoterpene
$\alpha$ -Fenchene	tr	Monoterpene
$\beta$ -Pinene	0.87	Monoterpene
Sabinene	0.55	Monoterpene
3-Methyl-3-cyclohexenone	tr	Aliphatic ketone
Myrcene	1.05	Monoterpene
Pseudolimonene	0.02	Monoterpene
$\alpha$ -Phellandrene	0.57	Monoterpene
$\alpha$ -Terpinene	11.91	Monoterpene
Carvomenthene	0.01	Aliphatic alcohol
para-Cymene	2.06	Monoterpene
Limonene	1.29	Monoterpene
1,8-Cineole	5.61	Monoterpenic ether
(Z)- $\beta$ -Ocimene	tr	Monoterpene
(E)- $\beta$ -Ocimene	0.02	Monoterpene
$\gamma$ -Terpinene	23.82	Monoterpene
cis-Sabinene hydrate	0.06	Monoterpenic alcohol
Terpinolene	4.42	Monoterpene
para-Cymenene	0.01	Monoterpene
trans-Sabinene hydrate	0.08	Monoterpenic alcohol
Linalool	0.07	Monoterpenic alcohol
para-Mentha-1,3,8-triene	tr	Monoterpene
endo-Fenchol	0.01	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.10	Monoterpenic alcohol
4-Hydroxy-4-methylcyclohex-2-enone	0.01	Aliphatic alcohol
Cosmene isomer I	0.02	Monoterpene
trans-para-Menth-2-en-1-ol	0.08	Monoterpenic alcohol
Unknown	0.01	Unknown
$\delta$ -Terpineol	0.01	Monoterpenic alcohol
Terpinen-4-ol	33.20	Monoterpenic alcohol
Dill ether	0.02	Monoterpenic ether
para-Cymen-8-ol	0.03	Monoterpenic alcohol
$\alpha$ -Terpineol	1.81	Monoterpenic alcohol
cis-Piperitol	0.03	Monoterpenic alcohol
trans-Piperitol	0.05	Monoterpenic alcohol
exo-2-Hydroxycineole	0.01	Monoterpenic alcohol
Nerol	0.01	Monoterpenic alcohol
Piperitone	tr	Monoterpenic ketone
trans-Ascaridole glycol	0.07	Monoterpenic alcohol

<i>cis</i> -Ascaridole glycol	0.04	Monoterpenic alcohol
Thymol	0.04	Monoterpenic alcohol
Carvacrol	0.01	Monoterpenic alcohol
Unknown	0.10	Monoterpenic alcohol
Bicycloelemene	0.02	Sesquiterpene
$\alpha$ -Cubebene	0.08	Sesquiterpene
Unknown	0.03	Unknown
Isoledene	0.08	Sesquiterpene
$\alpha$ -Copaene	0.13	Sesquiterpene
7-Cubebene	0.08	Sesquiterpene
7-Cubebene epimer?	0.03	Aliphatic alcohol
$\beta$ -Cubebene	0.02	Sesquiterpene
$\beta$ -Elemene	0.03	Sesquiterpene
$\alpha$ -Gurjunene	0.42	Sesquiterpene
Methyleugenol	0.02	Phenylpropanoid
$\beta$ -Maaliene	0.02	Sesquiterpene
$\beta$ -Caryophyllene	0.48	Sesquiterpene
$\gamma$ -Maaliene	0.06	Sesquiterpene
$\beta$ -Gurjunene	0.02	Sesquiterpene
$\alpha$ -Maaliene	0.07	Sesquiterpene
Aromadendrene	1.01	Sesquiterpene
Selina-5,11-diene	0.13	Sesquiterpene
Cadina-3,5-diene isomer I?	0.14	Sesquiterpene
<i>trans</i> -Muurolo-3,5-diene	0.12	Sesquiterpene
$\alpha$ -Humulene	0.11	Sesquiterpene
allo-Aromadendrene	0.41	Sesquiterpene
Valerena-4,7(11)-diene	0.03	Sesquiterpene
$\gamma$ -Gurjunene	0.04	Sesquiterpene
<i>trans</i> -Cadina-1(6),4-diene	0.29	Sesquiterpene
Selina-4,11-diene	0.05	Sesquiterpene
$\gamma$ -Muurolo-	0.03	Sesquiterpene
$\beta$ -Selinene	0.07	Sesquiterpene
allo-Aromadendr-9-ene	0.08	Sesquiterpene
<i>trans</i> -Muurolo-4(15),5-diene	0.05	Sesquiterpene
$\delta$ -Selinene	0.09	Sesquiterpene
Viridiflorene	0.71	Sesquiterpene
Bicyclogermacrene	0.48	Sesquiterpene
$\alpha$ -Muurolo-	0.12	Sesquiterpene
$\gamma$ -Cadinene	0.04	Sesquiterpene
<i>trans</i> -Calamenene	0.05	Sesquiterpene
$\delta$ -Cadinene	0.64	Sesquiterpene
Zonarene	0.19	Sesquiterpene
<i>trans</i> -Cadina-1,4-diene	0.12	Sesquiterpene
$\alpha$ -Calacorene	0.01	Sesquiterpene
Eudesma-5,7(11)-diene	0.02	Sesquiterpene
Palustrol	0.03	Sesquiterpenic alcohol
Spathulenol	0.03	Sesquiterpenic alcohol
Globulol	0.14	Sesquiterpenic alcohol
Gleenol	0.01	Sesquiterpenic alcohol
Viridiflorol	0.06	Sesquiterpenic alcohol
Cubeban-11-ol	0.05	Sesquiterpenic alcohol
Ledol?	0.05	Oxygenated sesquiterpene

Rosifoliol	0.05	Sesquiterpenic alcohol
1-epi-Cubenol	0.07	Sesquiterpenic alcohol
Isospathulenol	0.05	Sesquiterpenic alcohol
Cubenol	0.04	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.01	Sesquiterpenic alcohol
<b>Consolidated total</b>	<b>99.35%</b>	

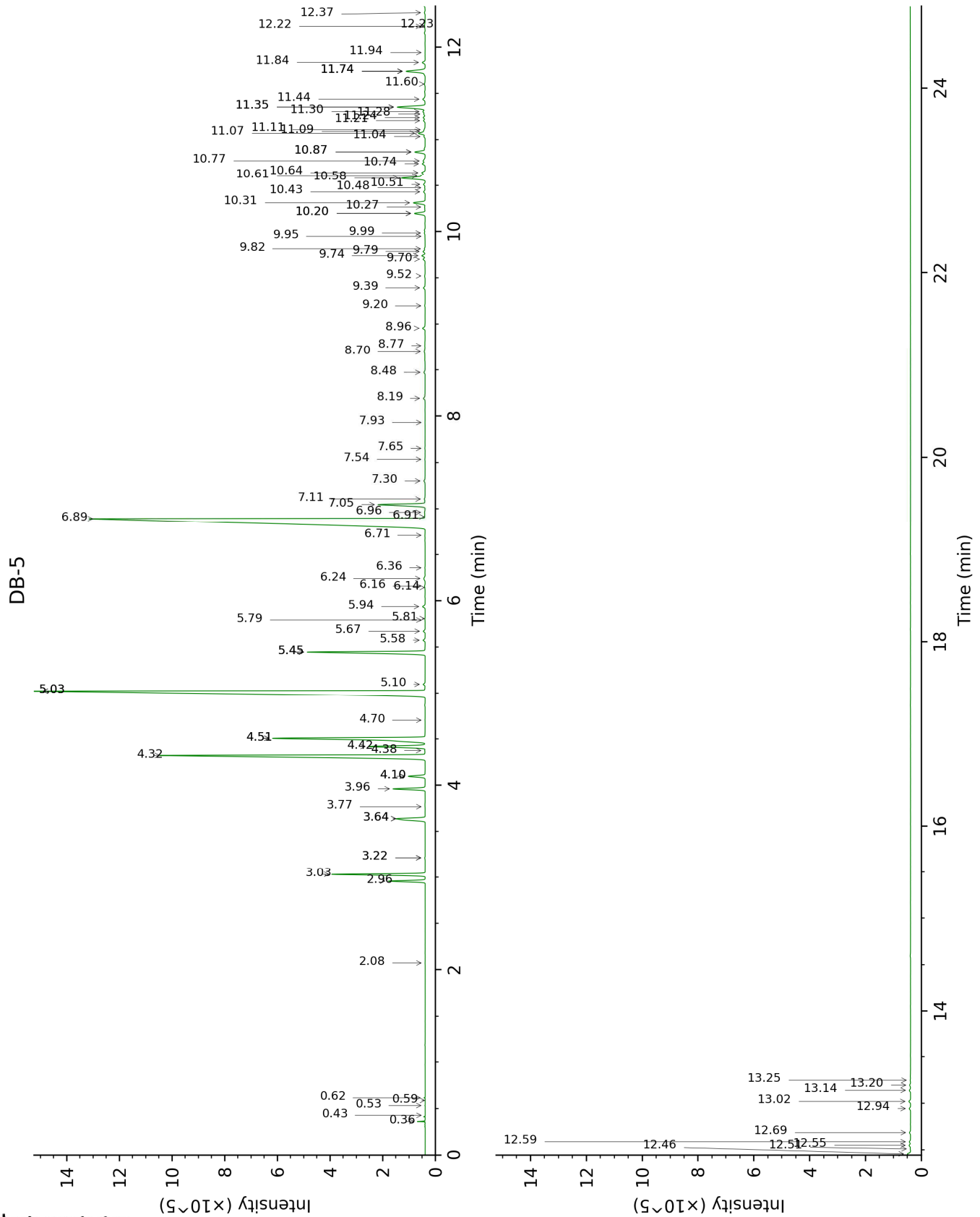
tr: The compound has been detected below 0.005% of total signal.

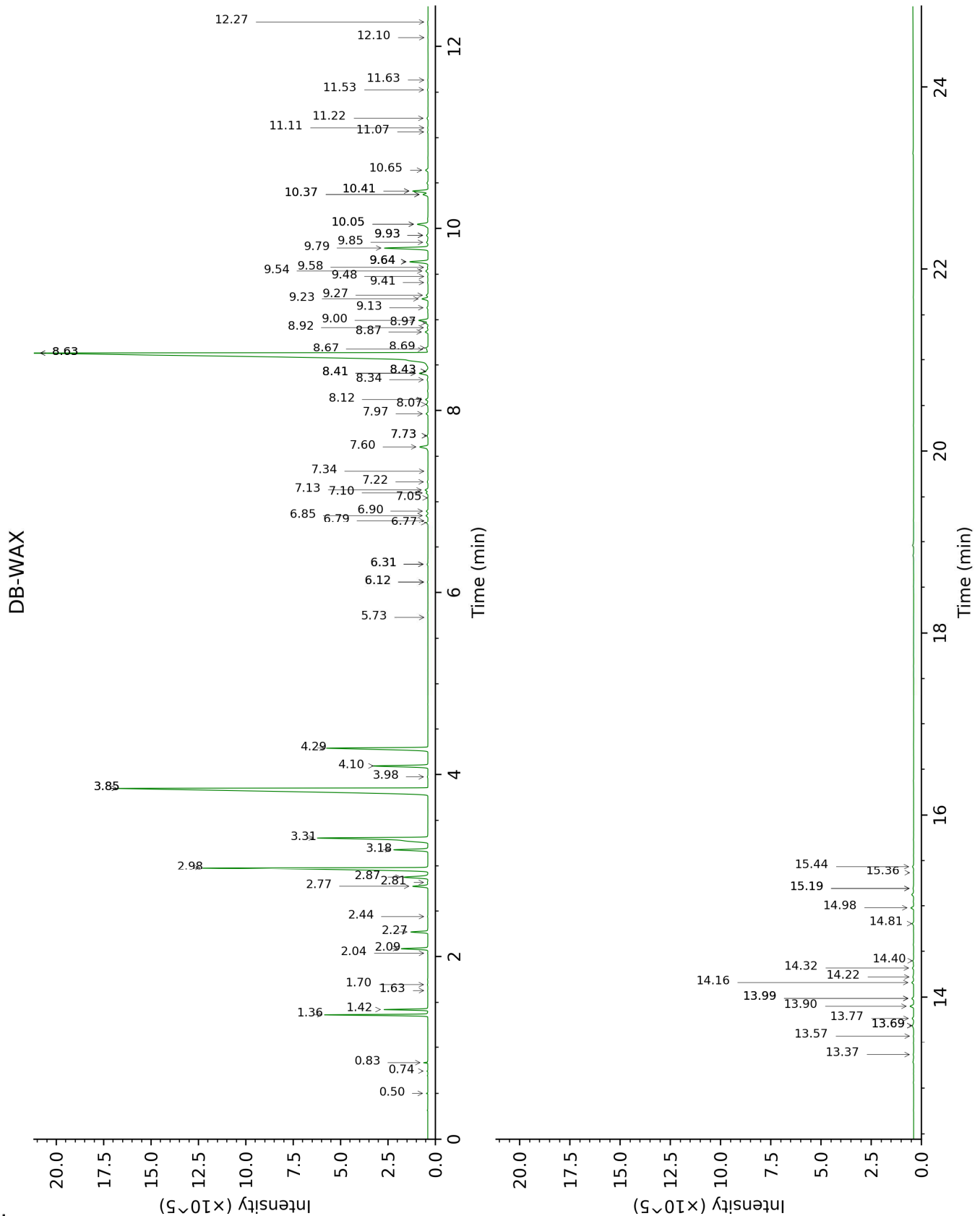
Note: no correction factor was applied

**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	%
Ethanol	0.36	519	0.07	0.84	903	0.07
Isobutyral	0.43	538	tr	0.50	774	0.02
Isobutanol	0.53	616	tr	2.04	1060	tr
Isovaleral	0.59	638	tr			
2-Methylbutyral	0.62	649	0.01	0.74	877	0.01
(3Z)-Hexenol	2.08	857	0.01	5.73	1343	tr
$\alpha$ -Thujene	2.96	925	1.11	1.42	999	1.12
$\alpha$ -Pinene	3.03	930	2.83	1.36	990	2.84
Camphene	3.22*	942	0.02	1.70	1026	0.01
$\alpha$ -Fenchene	3.22*	942	[0.02]	1.63	1019	tr
$\beta$ -Pinene	3.64*	970	1.41	2.09	1065	0.87
Sabinene	3.64*	970	[1.41]	2.27	1083	0.55
3-Methyl-3-cyclohexenone	3.77	979	tr	6.12*	1371	0.02
Myrcene	3.96	992	1.05	2.87	1133	1.07
Pseudolimonene	4.10*	1001	0.58	2.81	1128	0.02
$\alpha$ -Phellandrene	4.10*	1001	[0.58]	2.77	1125	0.57
$\alpha$ -Terpinene	4.32	1015	11.91	2.98	1141	11.95
Carvomenthene	4.38	1018	0.01	2.44	1099	0.01
para-Cymene	4.42	1021	2.06	4.10	1226	2.05
Limonene	4.51*	1027	6.99	3.18	1156	1.29
1,8-Cineole	4.51*	1027	[6.99]	3.31	1166	5.61
(Z)- $\beta$ -Ocimene	4.70	1039	tr	3.85*	1208	23.88
(E)- $\beta$ -Ocimene	5.02*	1059	23.84	3.98	1217	0.02
$\gamma$ -Terpinene	5.02*	1059	[23.84]	3.85*	1208	[23.88]
cis-Sabinene hydrate	5.10	1064	0.06	6.90	1428	0.06
Terpinolene	5.45*	1086	4.41	4.29	1240	4.42
para-Cymenene	5.45*	1086	[4.41]	6.31*	1385	0.03
trans-Sabinene hydrate	5.58	1094	0.08	7.97	1508	0.07
Linalool	5.67	1100	0.07	8.07	1516	0.09
para-Mentha-1,3,8-triene	5.79	1108	tr	6.12*	1371	[0.02]
endo-Fenchol	5.81	1109	0.01	8.41*	1542	0.47
cis-para-Menth-2-en-1-ol	5.94	1118	0.10	8.12	1520	0.10
4-Hydroxy-4-methylcyclohex-2-enone	6.14	1131	0.01	14.16	2035	0.07
Cosmene isomer I	6.16	1132	0.02	6.31*	1385	[0.03]
trans-para-Menth-2-en-1-ol	6.24	1137	0.08	8.97	1585	0.08
Unknown [m/z 109, 124 (45), 119 (41), 43 (35), 91 (28), 95 (25)...]	6.36	1145	0.01	6.80	1420	tr
$\delta$ -Terpineol	6.71	1168	0.01	9.48	1626	0.02

Terpinen-4-ol	6.89	1180	33.20	8.63*	1559	34.04
Dill ether	6.91	1182	0.02	7.34	1460	0.01
para-Cymen-8-ol	6.96	1185	0.03	11.53	1796	0.02
$\alpha$ -Terpineol	7.05	1190	1.81	9.79	1651	1.87
<i>cis</i> -Piperitol	7.11	1194	0.03	9.58	1634	0.03
<i>trans</i> -Piperitol	7.30	1207	0.05	10.41*	1702	0.69
exo-2-Hydroxycineole	7.54	1223	0.01	11.63	1805	0.01
Nerol	7.65	1231	0.01	11.11	1760	0.02
Piperitone	7.93	1251	tr	9.93*	1662	0.07
<i>trans</i> -Ascaridole glycol	8.19	1269	0.07	14.22	2041	0.04
<i>cis</i> -Ascaridole glycol	8.48	1288	0.04	14.81	2097	0.06
Thymol	8.70	1304	0.04	15.19*	2136	0.04
Carvacrol	8.77	1309	0.01	15.36	2153	0.01
Unknown [m/z 97, 112 (92), 83 (62), 43 (44), 41 (25)... 170? (4)]	8.96	1316	0.10	14.98	2114	0.11
Bicycloelemene	9.20	1334	0.02	7.05	1439	0.01
$\alpha$ -Cubebene	9.40	1348	0.08	6.77	1418	0.07
Unknown [m/z 43, 95 (62), 107 (45), 110 (41), 55 (28), 67 (25)...]	9.52	1356	0.03	13.99*	2019	0.07
Isoledene	9.70	1369	0.08	6.85	1424	0.08
$\alpha$ -Copaene	9.74	1372	0.13	7.13	1445	0.13
7-Cubebene	9.79	1375	0.08	7.10	1443	0.08
7-Cubebene epimer?	9.82	1377	0.03	7.22	1452	0.03
$\beta$ -Cubebene	9.95	1387	0.02	7.73*	1489	0.04
$\beta$ -Elemene	9.99	1389	0.03	8.43*	1544	0.08
$\alpha$ -Gurjunene	10.20*	1404	0.44	7.60	1480	0.42
Methyleugenol	10.20*	1404	[0.44]	13.37	1960	0.02
$\beta$ -Maaliene	10.27	1409	0.02	7.73*	1489	[0.04]
$\beta$ -Caryophyllene	10.31	1413	0.48	8.41*	1542	[0.47]
$\gamma$ -Maaliene	10.43	1422	0.06	8.43*	1544	[0.08]
$\beta$ -Gurjunene	10.48	1425	0.02	8.34	1536	0.05
$\alpha$ -Maaliene	10.51	1428	0.07	8.67	1562	0.06
Aromadendrene	10.58	1433	1.01	8.63*	1559	[34.04]
Selina-5,11-diene	10.60	1435	0.13	8.69	1564	0.13
Cadina-3,5-diene isomer I?	10.64	1438	0.14			
<i>trans</i> -Muuroala-3,5-diene	10.74	1445	0.12	8.87	1577	0.11
$\alpha$ -Humulene	10.77	1447	0.11	9.27	1609	0.07
allo-Aromadendrene	10.87*	1454	0.42	9.00	1587	0.41
Valerena-4,7(11)-diene	10.87*	1454	[0.42]	8.92	1581	0.03
$\gamma$ -Gurjunene	11.04	1467	0.04	9.14	1598	0.06

<i>trans</i> -Cadina-1(6),4-diene	11.07	1469	0.29	9.23	1606	0.26
Selina-4,11-diene	11.09	1471	0.05	9.41	1620	0.02
$\gamma$ -Muurolene	11.11	1472	0.03	9.64*	1639	0.83
$\beta$ -Selinene	11.21	1480	0.07	9.93*	1662	[0.07]
allo-Aromadendrene	11.24	1482	0.08	9.54	1630	0.11
<i>trans</i> -Muurola-4(15),5-diene	11.28	1485	0.05	9.85	1656	0.08
$\delta$ -Selinene	11.30	1487	0.09	9.64*	1639	[0.83]
Viridiflorene	11.35*	1490	1.28	9.64*	1639	[0.83]
Bicyclogermacrene	11.35*	1490	[1.28]	10.05*	1672	0.60
$\alpha$ -Muurolene	11.44	1497	0.12	10.05*	1672	[0.60]
$\gamma$ -Cadinene	11.60	1509	0.04	10.37*	1698	0.23
<i>trans</i> -Calamenene	11.74*	1520	0.91	11.22	1769	0.05
$\delta$ -Cadinene	11.74*	1520	[0.91]	10.41*	1702	[0.69]
Zonarene	11.74*	1520	[0.91]	10.37*	1698	[0.23]
<i>trans</i> -Cadina-1,4-diene	11.84	1528	0.12	10.65	1721	0.11
$\alpha$ -Calacorene	11.94	1536	0.01	12.10	1846	0.01
Eudesma-5,7(11)-diene	12.22	1558	0.02	11.07	1757	0.02
Palustrol	12.23	1559	0.03	12.27	1861	0.02
Spathulenol	12.37	1570	0.03	14.40	2058	0.04
Globulol	12.46	1576	0.14	13.90	2010	0.15
Gleenol	12.51	1581	0.01	13.58	1980	0.01
Viridiflorol	12.55	1584	0.06	13.99*	2019	[0.07]
Cubeban-11-ol	12.59	1587	0.05	13.69*	1990	0.09
Ledol?	12.69	1594	0.05			
Rosifoliol	12.94	1615	0.05	14.32	2050	0.05
1-epi-Cubenol	13.02	1622	0.07	13.77	1998	0.07
Isospathulenol	13.14	1631	0.05	15.44	2160	0.05
Cubenol	13.20	1636	0.04	13.69*	1990	[0.09]
$\alpha$ -Muurolol	13.25	1640	0.01	15.19*	2136	[0.04]
<b>Total identified</b>		<b>99.40%</b>			<b>99.07%</b>	
<b>Total reported</b>		<b>99.54%</b>			<b>99.19%</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