

**Date :** January 23, 2019

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 19A10-ORA12-1-CC

**Customer identification :** Juniper

**Type :** Essential oil

**Source :** *Juniperus communis*

**Customer :** Organic Aromas Inc.

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

**Analysis date :** January 16, 2019

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:**  $1.4710 \pm 0.0003$  (20 °C)

*CONCLUSION*

No clear adulterant, contaminant or diluent has been detected using this method. Please note that Indian juniper oil appears to be more variable than and different from European juniper berry oil.

ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
2-Methylfuran	tr	tr*	Furan
3-Methylfuran	tr	[tr]*	Furan
Toluene	tr	0.36*	Simple phenolic
Hashishene	tr	61.62*	Monoterpene
Tricyclene	0.06	0.06	Monoterpene
$\alpha$ -Thujene	0.33	[0.36]*	Monoterpene
$\alpha$ -Pinene	61.63	[61.62]*	Monoterpene
Camphene	0.75*	0.70	Monoterpene
$\alpha$ -Fenchene	[0.75]*	0.05	Monoterpene
Thuja-2,4(10)-diene	0.04	2.67*	Monoterpene
Unknown	0.02		Monoterpene
Unknown	0.01	0.01	Monoterpene
meta-Cymene	tr	5.47*	Monoterpene
$\beta$ -Pinene	12.94*	10.22	Monoterpene
Sabinene	[12.94]*	[2.67]*	Monoterpene
Unknown	0.09	0.06	Monoterpene
Octen-3-ol	0.01	0.26*	Aliphatic alcohol
6-Methyl-5-hepten-2-one	0.02	0.02*	Aliphatic ketone
Myrcene	5.51	[5.47]*	Monoterpene
2-Carene	0.04	0.03	Monoterpene
$\alpha$ -Phellandrene	0.23*	0.17	Monoterpene
Menthatriene isomer I	[0.23]*	0.01	Monoterpene
Pseudolimonene	[0.23]*	0.04	Monoterpene
$\Delta$ 3-Carene	0.03	0.03	Monoterpene
$\alpha$ -Terpinene	0.19*	0.18*	Monoterpene
1,4-Cineole	[0.19]*	[0.18]*	Monoterpenic ether
ortho-Cymene	0.01	0.70*	Simple phenolic
para-Cymene	0.70	[0.70]*	Monoterpene
Limonene	3.90*	3.49	Monoterpene
$\beta$ -Phellandrene	[3.90]*	0.38	Monoterpene
(Z)- $\beta$ -Ocimene	0.01	0.01	Monoterpene
(E)- $\beta$ -Ocimene	0.01	0.01	Monoterpene
$\gamma$ -Terpinene	0.59	0.60	Monoterpene
cis-Sabinene hydrate	0.01	0.01	Monoterpenic alcohol
Unknown	0.02	0.01	Oxygenated monoterpene
Fenchone	0.01		Aliphatic alcohol
Terpinolene	0.80*	0.77	Monoterpene
para-Cymenene	[0.80]*	[0.02]*	Monoterpene
$\alpha$ -Pinene oxide	0.12	0.11	Monoterpenic ether
trans-Sabinene hydrate	0.01	0.01	Monoterpenic alcohol
Linalool	0.17	0.97*	Monoterpenic alcohol
Nonanal	0.01		Aliphatic aldehyde
endo-Fenchol	0.08	0.10	Monoterpenic alcohol
cis-para-Menth-2-en-1-ol	0.03	0.02	Monoterpenic alcohol
trans-Pinocarveol	0.13	0.12	Monoterpenic alcohol
cis-Verbenol	0.02	0.01	Monoterpenic alcohol
trans-Verbenol	0.11*	0.10	Monoterpenic alcohol
Camphene hydrate	[0.11]*	0.01	Monoterpenic alcohol

Epoxyterpinolene	0.04	0.04	Monoterpenic ether
meta-Mentha-4,6-dien-8-ol	0.01	0.51*	Monoterpenic alcohol
Citronellal	0.01	0.03	Monoterpenic aldehyde
Pinocamphone	0.02	0.01*	Monoterpenic ketone
Pinocarvone	0.01	0.04*	Monoterpenic ketone
Borneol	0.07	0.59*	Monoterpenic alcohol
$\alpha$ -Phellandren-8-ol	0.01	0.02	Monoterpenic alcohol
Terpinen-4-ol	0.84	0.86*	Monoterpenic alcohol
para-Cymen-8-ol	0.09	0.07	Monoterpenic alcohol
$\alpha$ -Terpineol	0.89	0.98	Monoterpenic alcohol
Myrtenal	0.12*	0.04*	Monoterpenic aldehyde
Myrtenol	[0.12]*	0.07	Monoterpenic alcohol
Verbenone	0.04	0.11*	Monoterpenic ketone
Decanal	0.01	[0.01]*	Aliphatic aldehyde
endo-Fenchyl acetate	0.02*	[0.26]*	Monoterpenic ester
<i>trans</i> -Carveol	[0.02]*	0.03	Monoterpenic alcohol
<i>cis</i> -Carveol	0.01	0.02	Monoterpenic alcohol
Citronellol	0.03*	0.05	Monoterpenic alcohol
Thymol methyl ether	[0.03]*	2.94*	Monoterpenic ether
Unknown	[0.03]*	0.03	Oxygenated monoterpene
Carvone	0.01*	0.07*	Monoterpenic ketone
Neral	[0.01]*	0.03*	Monoterpenic aldehyde
Geraniol	0.01	0.01	Monoterpenic alcohol
Methyl citronellate	0.01	0.01	Monoterpenic ester
Geranial	0.01	0.01	Monoterpenic aldehyde
Bornyl acetate	0.11	0.26	Monoterpenic ester
2-Undecanone	0.01	0.01	Aliphatic ketone
Thymol	0.01	0.02*	Monoterpenic alcohol
Myrtenyl acetate	0.01	[0.11]*	Monoterpenic ester
Bicycloelemene	0.02	0.02	Sesquiterpene
$\alpha$ -Cubebene	0.11*	[0.26]*	Sesquiterpene
$\alpha$ -Terpinyl acetate	[0.11]*	0.04	Monoterpenic ester
$\gamma$ -Terpinyl acetate	0.17	0.13	Monoterpenic ester
Citronellyl acetate	0.02	[0.03]*	Monoterpenic ester
$\alpha$ -Ylangene	0.03	0.03	Sesquiterpene
$\alpha$ -Copaene	0.22	0.22	Sesquiterpene
<i>cis</i> - $\beta$ -Elemene	0.01	0.03	Sesquiterpene
$\beta$ -Cubebene	0.08	0.09	Sesquiterpene
$\beta$ -Elemene	0.21	[2.94]*	Sesquiterpene
Longifolene	0.94*	[0.97]*	Sesquiterpene
Sibirene	[0.94]*	[0.04]*	Sesquiterpene
$\alpha$ -Gurjunene	0.02	0.01	Sesquiterpene
$\beta$ -Caryophyllene	2.66	[2.94]*	Sesquiterpene
$\beta$ -Copaene	0.02	[2.94]*	Sesquiterpene
<i>cis</i> -Thujopsene	0.02	[0.04]*	Sesquiterpene
$\gamma$ -Elemene	0.06	0.06	Sesquiterpene
Aromadendrene	0.02	[0.86]*	Sesquiterpene
$\alpha$ -Himachalene	0.01	0.01	Sesquiterpene
$\alpha$ -Humulene	0.48	[0.51]*	Sesquiterpene
allo-Aromadendrene	0.03	0.02	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.09*	[0.11]*	Sesquiterpene
$\beta$ -Acoradiene	[0.09]*	0.02	Sesquiterpene

<i>trans</i> -Cadina-1(6),4-diene	0.06	0.06	Sesquiterpene
$\gamma$ -Muurolene	0.11	[0.11]*	Sesquiterpene
Germacrene D	0.58	[0.59]*	Sesquiterpene
$\beta$ -Selinene	0.06	0.05	Sesquiterpene
$\gamma$ -Amorphene	0.04	[0.59]*	Sesquiterpene
$\alpha$ -Selinene	0.17*	[0.07]*	Sesquiterpene
Bicyclogermacrene	[0.17]*	0.10*	Sesquiterpene
Cuparene	0.11*	0.01	Sesquiterpene
$\alpha$ -Muurolene	[0.11]*	[0.10]*	Sesquiterpene
$\gamma$ -Cadinene	0.17	0.23*	Sesquiterpene
$\delta$ -Cadinene	0.56*	0.49	Sesquiterpene
<i>cis</i> -Calamenene?	[0.56]*	0.29*	Sesquiterpene
Selina-4(15),7(11)-diene	0.06*	0.04*	Sesquiterpene
( <i>E</i> )- $\gamma$ -Bisabolene	[0.06]*	[0.23]*	Sesquiterpene
$\alpha$ -Cadinene	0.02	0.02	Sesquiterpene
Selina-3,7(11)-diene	0.02	[0.04]*	Sesquiterpene
$\alpha$ -Elemol	0.04	0.02	Sesquiterpenic alcohol
Germacrene B	0.29	[0.29]*	Sesquiterpene
Spathulenol	0.03	0.03	Sesquiterpenic alcohol
Caryophyllene oxide	0.40*	0.32	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.40]*	0.09	Sesquiterpenic ether
Humulene epoxide II	0.04	0.05	Sesquiterpenic ether
10- <i>epi</i> -Cubenol	0.02	0.03	Sesquiterpenic alcohol
1,10- <i>diepi</i> -Cubenol	0.04	0.06	Sesquiterpenic alcohol
$\tau$ -Cadinol	0.04*	0.02	Sesquiterpenic alcohol
$\tau$ -Muurolol	[0.04]*	[0.02]*	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.02	0.02	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.04	0.04*	Sesquiterpenic alcohol
meta-Camphorene	0.03	[0.04]*	Diterpene
para-Camphorene	0.01	0.02	Diterpene
<b>Total identified</b>	<b>99.11%</b>	<b>98.80%</b>	

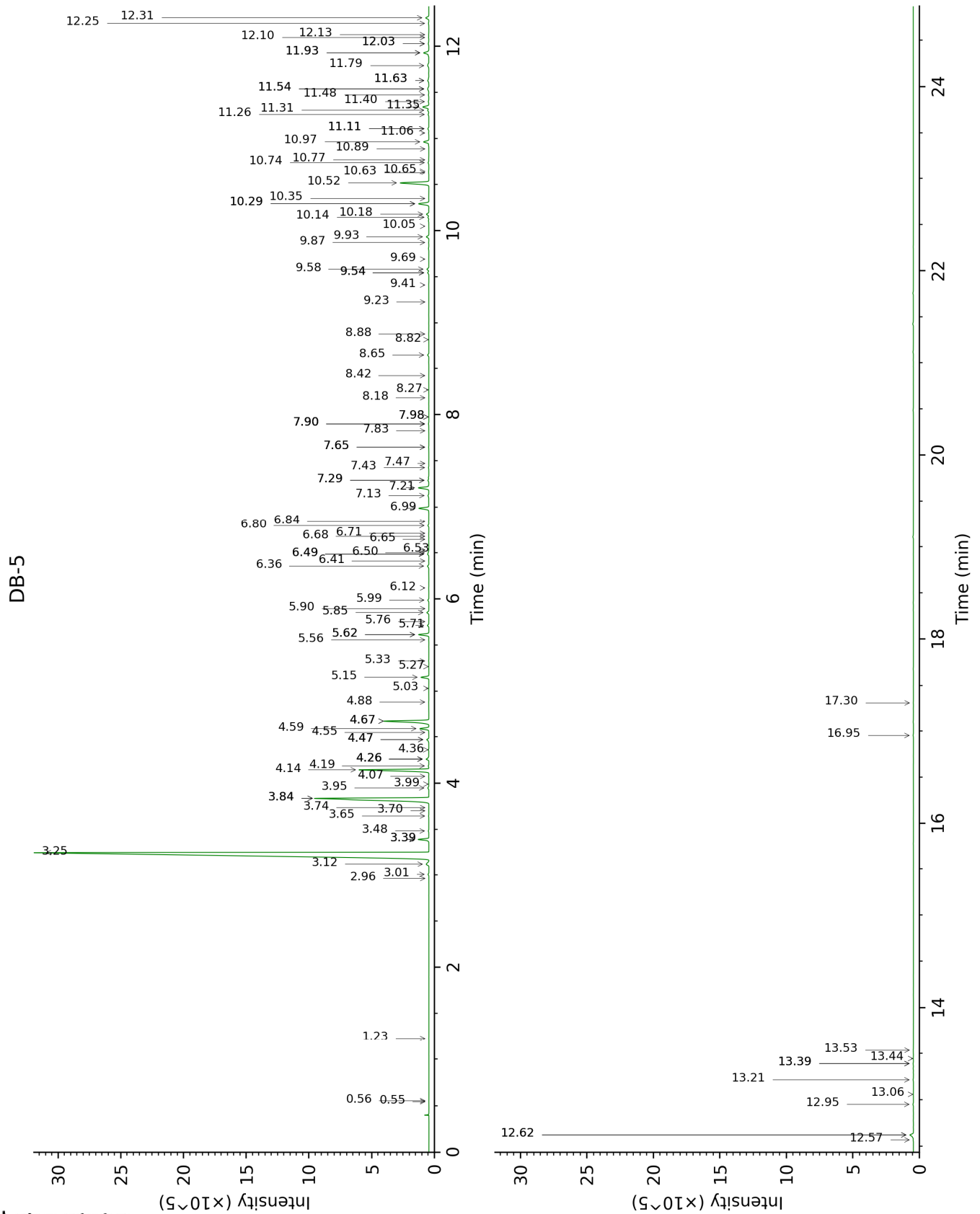
\*: Two or more compounds are coeluting on this column

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

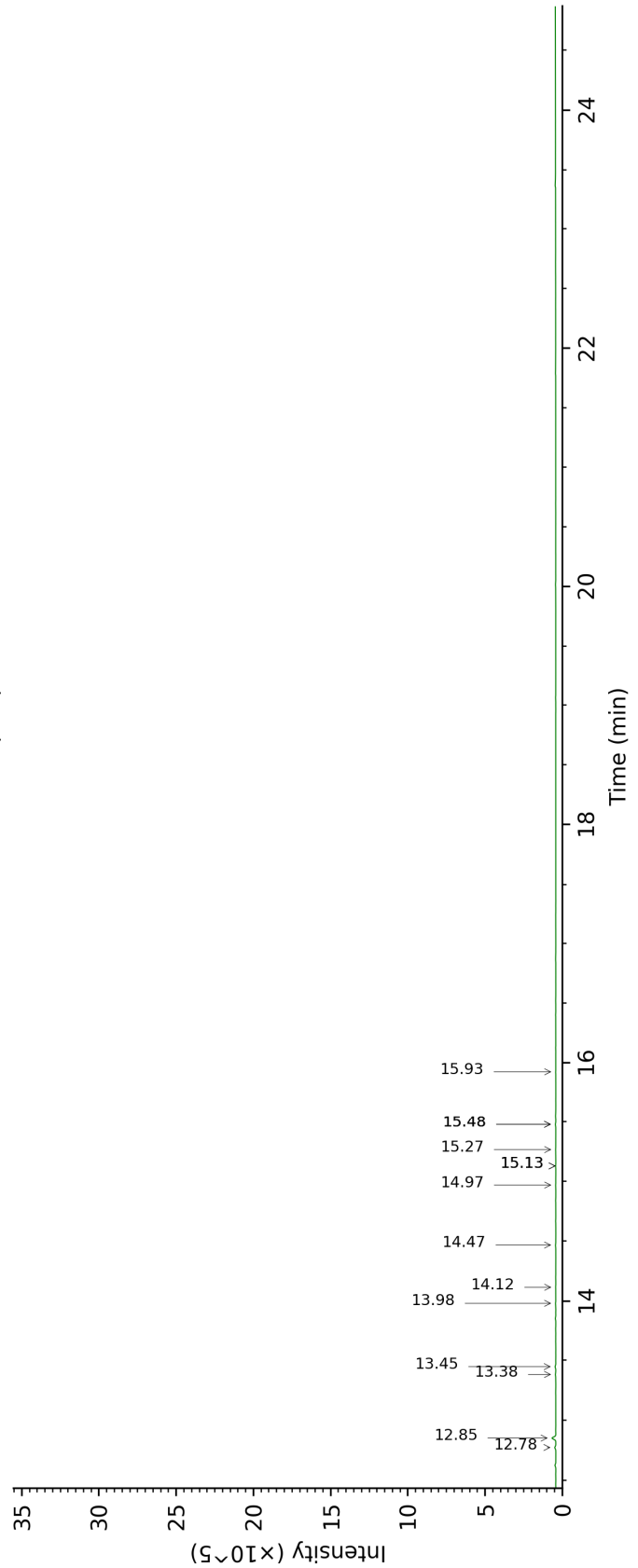
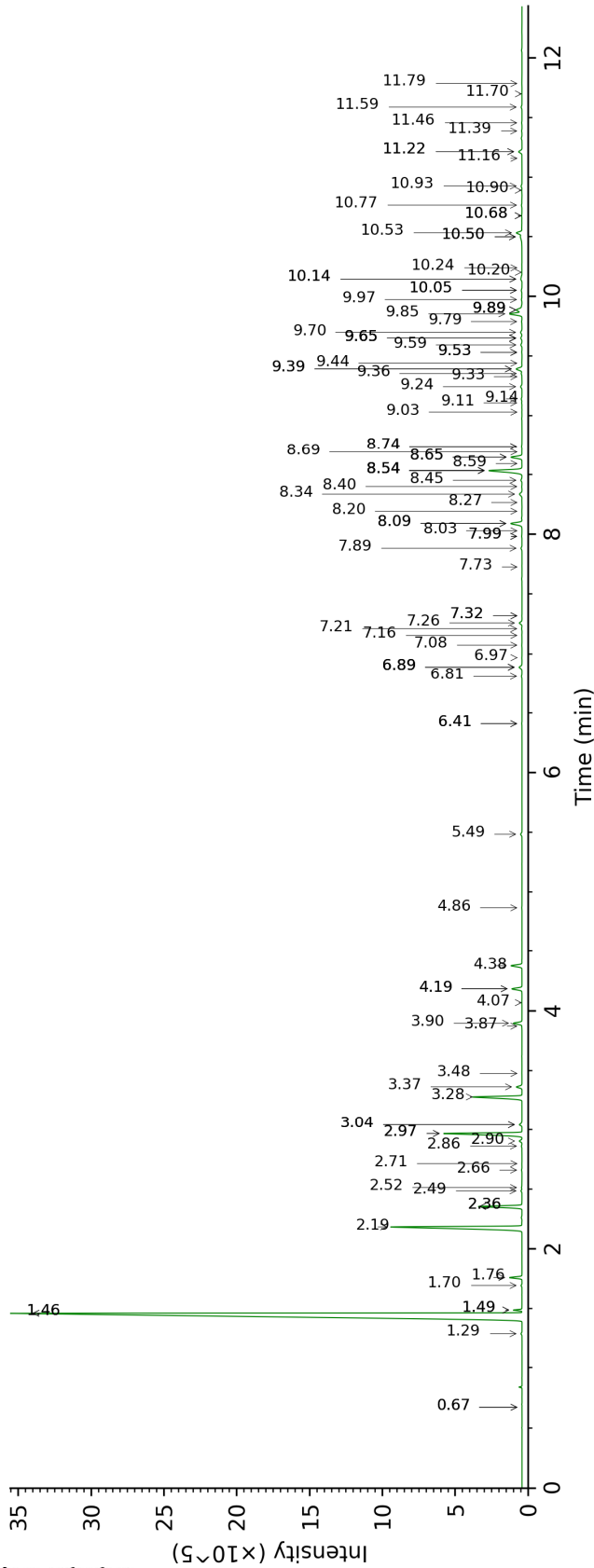
tr: The compound has been detected below 0.005% of total signal.

Note: no correction factor was applied

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DB-WAX





FULL ANALYSIS DATA

Identification	Column DB-5			Column DB-WAX		
	R.T	R.I	%	R.T	R.I	%
2-Methylfuran	0.54	605	tr	0.67*	858	tr
3-Methylfuran	0.56	611	tr	0.67*	858	[tr]
Toluene	1.23	756	tr	1.49*	1004	0.36
Hashishene	2.96	914	tr	1.46*	1001	61.62
Tricyclene	3.01	917	0.06	1.29	976	0.06
$\alpha$ -Thujene	3.12	925	0.33	1.49*	1004	[0.36]
$\alpha$ -Pinene	3.25	933	61.63	1.46*	1001	[61.62]
Camphene	3.39*	942	0.75	1.76	1029	0.70
$\alpha$ -Fenchene	3.39*	942	[0.75]	1.70	1023	0.05
Thuja-2,4(10)-diene	3.48	948	0.04	2.36*	1086	2.67
Unknown [m/z 121, 93 (86), 79 (71), 67 (62), 55 (49)... 136 (24)]	3.64	959	0.02			
Unknown [m/z 91, 119 (60), 77 (36), 92 (31), 93 (31)... 134 (23)]	3.70	963	0.01	2.72	1116	0.01
meta-Cymene	3.74	965	tr	2.97*	1136	5.47
$\beta$ -Pinene	3.84*	972	12.94	2.19	1069	10.22
Sabinene	3.84*	972	[12.94]	2.36*	1086	[2.67]
Unknown [m/z 93, 79 (73), 67 (49), 95 (42), 91 (41), 121 (38)...]	3.95	979	0.09	2.49	1098	0.06
Octen-3-ol	3.99	982	0.01	6.89*	1423	0.26
6-Methyl-5-hepten-2-one	4.07	987	0.02	6.41*	1387	0.02
Myrcene	4.14	992	5.51	2.97*	1136	[5.47]
2-Carene	4.19	995	0.04	2.52	1101	0.03
$\alpha$ -Phellandrene	4.26*	1000	0.23	2.90	1131	0.17
Menthatriene isomer I	4.26*	1000	[0.23]	3.48	1176	0.01
Pseudolimonene	4.26*	1000	[0.23]	2.86	1128	0.04
$\Delta$ 3-Carene	4.36	1006	0.03	2.66	1112	0.03
$\alpha$ -Terpinene	4.47*	1013	0.19	3.04*	1142	0.18
1,4-Cineole	4.47*	1013	[0.19]	3.04*	1142	[0.18]
ortho-Cymene	4.55	1018	0.01	4.19*	1232	0.70
para-Cymene	4.59	1020	0.70	4.19*	1232	[0.70]
Limonene	4.67*	1026	3.90	3.28	1161	3.49
$\beta$ -Phellandrene	4.67*	1026	[3.90]	3.36	1168	0.38
(Z)- $\beta$ -Ocimene	4.88	1038	0.01	3.87	1208	0.01
(E)- $\beta$ -Ocimene	5.03	1048	0.01	4.07	1223	0.01
$\gamma$ -Terpinene	5.15	1056	0.59	3.90	1210	0.60
cis-Sabinene hydrate	5.27	1063	0.01	6.97	1429	0.01
Unknown [m/z 79,	5.33	1067	0.02	4.86	1284	0.01

93 (60), 43 (40), 94 (35), 137 (33), 77 (26), 91 (20), 152 (18)]						
Fenchone	5.56	1081	0.01			
Terpinolene	5.62*	1085	0.80	4.38	1246	0.77
para-Cymenene	5.62*	1085	[0.80]	6.41*	1387	[0.02]
α-Pinene oxide	5.71	1091	0.12	5.49	1320	0.11
<i>trans</i> -Sabinene hydrate	5.76	1094	0.01	8.03	1509	0.01
Linalool	5.85	1100	0.17	8.09*	1514	0.97
Nonanal	5.90	1103	0.01			
endo-Fenchol	5.99	1109	0.08	8.45	1542	0.10
<i>cis</i> -para-Menth-2-en-1-ol	6.12	1117	0.03	8.20	1522	0.02
<i>trans</i> -Pinocarveol	6.36	1132	0.13	9.24	1604	0.12
<i>cis</i> -Verbenol	6.41	1136	0.02	9.33	1611	0.01
<i>trans</i> -Verbenol	6.49*	1141	0.11	9.59	1632	0.10
Camphene hydrate	6.49*	1141	[0.11]	8.59	1553	0.01
Epoxyterpinolene	6.50	1142	0.04	6.81	1417	0.04
meta-Mentha-4,6-dien-8-ol	6.53	1144	0.01	9.39*	1616	0.51
Citronellal	6.65	1151	0.01	7.08	1437	0.03
Pinocamphone	6.68	1153	0.02	7.32*	1455	0.01
Pinocarvone	6.71	1155	0.01	7.98*	1505	0.04
Borneol	6.80	1161	0.07	9.89*	1656	0.59
α-Phellandren-8-ol	6.84	1164	0.01	10.20	1682	0.02
Terpinen-4-ol	6.99	1173	0.84	8.65*	1557	0.86
para-Cymen-8-ol	7.13	1182	0.09	11.59	1800	0.07
α-Terpineol	7.21	1188	0.89	9.85	1654	0.98
Myrtenal	7.29*†	1193	0.12	8.74*	1564	0.04
Myrtenol	7.29*†	1193	[0.12]	10.93	1744	0.07
Verbenone	7.43	1202	0.04	9.65*	1637	0.11
Decanal	7.47	1205	0.01	7.32*	1455	[0.01]
endo-Fenchyl acetate	7.65*	1217	0.02	6.89*	1423	[0.26]
<i>trans</i> -Carveol	7.65*	1217	[0.02]	11.46	1789	0.03
<i>cis</i> -Carveol	7.83	1229	0.01	11.79	1817	0.02
Citronellol	7.90*	1234	0.03	10.77	1730	0.05
Thymol methyl ether	7.90*	1234	[0.03]	8.54*	1548	2.94
Unknown [m/z 137, 152 (28), 43 (25), 91 (24), 109 (23), 119 (19)]	7.90*	1234	[0.03]	11.39	1783	0.03
Carvone	7.98*	1239	0.01	10.05*	1670	0.07
Neral	7.98*	1239	[0.01]	9.53*	1627	0.03
Geraniol	8.18	1254	0.01	11.70	1810	0.01
Methyl citronellate	8.27	1259	0.01	8.27	1527	0.01
Geranial	8.42	1270	0.01	10.24	1685	0.01
Bornyl acetate	8.65	1285	0.11	8.34	1533	0.26

2-Undecanone	8.82	1297	0.01	8.69	1560	0.01
Thymol	8.88	1301	0.01	15.13*	2131	0.02
Myrtenyl acetate	9.23	1322	0.01	9.65*	1637	[0.11]
Bicycloelemene	9.41	1335	0.02	7.16	1443	0.02
$\alpha$ -Cubebene	9.54*	1345	0.11	6.89*	1423	[0.26]
$\alpha$ -Terpinyl acetate	9.54*	1345	[0.11]	9.79	1648	0.04
$\gamma$ -Terpinyl acetate	9.58	1347	0.17	9.70	1641	0.13
Citronellyl acetate	9.69	1355	0.02	9.53*	1627	[0.03]
$\alpha$ -Ylangene	9.87	1368	0.03	7.21	1447	0.03
$\alpha$ -Copaene	9.93	1372	0.22	7.26	1451	0.22
<i>cis</i> - $\beta$ -Elemene	10.05	1380	0.01	8.40	1538	0.03
$\beta$ -Cubebene	10.14	1387	0.08	7.89	1498	0.09
$\beta$ -Elemene	10.18	1390	0.21	8.54*	1548	[2.94]
Longifolene	10.29*	1398	0.94	8.09*	1514	[0.97]
Sibirene	10.29*	1398	[0.94]	7.98*	1505	[0.04]
$\alpha$ -Gurjunene	10.35	1402	0.02	7.73	1486	0.01
$\beta$ -Caryophyllene	10.52	1414	2.66	8.54*	1548	[2.94]
$\beta$ -Copaene	10.63	1423	0.02	8.54*	1548	[2.94]
<i>cis</i> -Thujopsene	10.65	1424	0.02	8.74*	1564	[0.04]
$\gamma$ -Elemene	10.74	1431	0.06	9.14	1596	0.06
Aromadendrene	10.77	1433	0.02	8.65*	1557	[0.86]
$\alpha$ -Himachalene	10.89	1442	0.01	9.03	1587	0.01
$\alpha$ -Humulene	10.97	1448	0.48	9.39*	1616	[0.51]
allo-Aromadendrene	11.06	1455	0.03	9.11	1593	0.02
( <i>E</i> )- $\beta$ -Farnesene	11.11*	1459	0.09	9.65*	1637	[0.11]
$\beta$ -Acoradiene	11.11*	1459	[0.09]	9.44	1620	0.02
<i>trans</i> -Cadinene-1(6),4-diene	11.26	1470	0.06	9.36	1613	0.06
$\gamma$ -Muurolole	11.31	1474	0.11	9.65*	1637	[0.11]
Germacrene D	11.35	1476	0.58	9.89*	1656	[0.59]
$\beta$ -Selinene	11.40	1480	0.06	9.97	1663	0.05
$\gamma$ -Amorphene	11.48	1486	0.04	9.89*	1656	[0.59]
$\alpha$ -Selinene	11.54*	1491	0.17	10.05*	1670	[0.07]
Bicyclogermacrene	11.54*	1491	[0.17]	10.14*	1677	0.10
Cuparene	11.63*	1498	0.11	11.16	1763	0.01
$\alpha$ -Muurolole	11.63*	1498	[0.11]	10.14*	1677	[0.10]
$\gamma$ -Cadinene	11.79	1510	0.17	10.50*	1706	0.23
$\delta$ -Cadinene	11.93*	1521	0.56	10.53	1709	0.49
<i>cis</i> -Calamenene?	11.93*	1521	[0.56]	11.22*	1768	0.29
Selina-4(15),7(11)-diene	12.03*	1529	0.06	10.68*	1722	0.04
( <i>E</i> )- $\gamma$ -Bisabolene	12.03*	1529	[0.06]	10.50*	1706	[0.23]
$\alpha$ -Cadinene	12.10	1534	0.02	10.90	1740	0.02
Selina-3,7(11)-diene	12.13	1536	0.02	10.68*	1722	[0.04]
$\alpha$ -Elemol	12.25	1546	0.04	14.12	2031	0.02
Germacrene B	12.31	1551	0.29	11.22*	1768	[0.29]
Spathulenol	12.57	1571	0.03	14.47	2066	0.03
Caryophyllene oxide	12.62*	1575	0.40	12.85	1913	0.32
Caryophyllene	12.62*	1575	[0.40]	12.78	1906	0.09

oxide isomer						
Humulene epoxide II	12.95	1601	0.04	13.38	1962	0.05
10-epi-Cubenol	13.06	1610	0.02	13.98	2018	0.03
1,10-diepi-Cubenol	13.22	1623	0.04	13.45	1968	0.06
τ-Cadinol	13.39*	1638	0.04	14.97	2115	0.02
τ-Muurolol	13.39*	1638	[0.04]	15.13*	2131	[0.02]
α-Muurolol	13.44	1642	0.02	15.27	2144	0.02
α-Cadinol	13.53	1649	0.04	15.48*	2166	0.04
meta-Camphorene	16.95	1952	0.03	15.48*	2166	[0.04]
para-Camphorene	17.30	1986	0.01	15.93	2211	0.02
<b>Total identified</b>		<b>99.11%</b>			<b>98.80%</b>	
<b>Total reported</b>		<b>99.24%</b>			<b>98.91%</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