

**Date :** February 25, 2022

**CERTIFICATE OF ANALYSIS – GC PROFILING**

**SAMPLE IDENTIFICATION**

**Internal code :** 22B11-ZAA05

**Customer identification :** Balsam Fir - Canada - EAB224225CA63720E

**Type :** Essential oil

**Source :** *Abies balsamea* ct. Eastern / Low thymol

**Customer :** ZAYAT AROMA

**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 :** Pamela Lavoie, M.Sc., Chimiste

**Analysis date :** February 23, 2022

Checked and approved by :

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

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#### PHYSICOCHEMICAL DATA

**Physical aspect:** Clear liquid

**Refractive index:**  $1.4741 \pm 0.0003$  (20 °C; method PC-MAT-016)

**Relative density:** 0.870 (method PC-MAT-017)

**Optical rotation:**  $-26.4^\circ$

#### 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
3-Methylfuran	0.01	Furan
Isovaleral	tr	Aliphatic aldehyde
Toluene	0.02	Simple phenolic
Unknown	0.01	Unknown
Hexanal	0.01	Aliphatic aldehyde
Unknown	0.01	Unknown
Santene	1.20	Normonoterpene
Styrene	0.01	Simple phenolic
Unknown	0.03	Normonoterpene
Bornylene	0.01	Monoterpene
Tricyclene	0.66	Monoterpene
$\alpha$ -Thujene	0.14	Monoterpene
$\alpha$ -Pinene	19.39	Monoterpene
Camphene	4.43	Monoterpene
$\alpha$ -Fenchene	0.12	Monoterpene
Thuja-2,4(10)-diene	0.05	Monoterpene
3,7,7-Trimethylcyclohepta-1,3,5-triene	0.04	Monoterpene
$\beta$ -Pinene	32.22	Monoterpene
Sabinene	0.06	Monoterpene
Unknown	0.02	Monoterpene
Myrcene	2.48	Monoterpene
2-Carene	0.01	Monoterpene
$\alpha$ -Phellandrene	0.23	Monoterpene
Pseudolimonene	0.02	Monoterpene
(3Z)-Hexenyl acetate	tr	Aliphatic ester
$\Delta^3$ -Carene	9.25	Monoterpene
$\alpha$ -Terpinene	0.20	Monoterpene
meta-Cymene	tr	Monoterpene
Carvomenthene	0.02	Aliphatic alcohol
para-Cymene	0.19	Monoterpene
Limonene	13.18	Monoterpene
$\beta$ -Phellandrene	5.01	Monoterpene
(Z)- $\beta$ -Ocimene	0.01	Monoterpene
$\gamma$ -Terpinene	0.27	Monoterpene
Unknown	0.01	Oxygenated monoterpene
meta-Cymenene	0.01	Monoterpene
Isoterpinolene	0.04	Monoterpene
Fenchone	0.10	Monoterpenic ketone
Terpinolene	1.05	Monoterpene
$\gamma$ -Campholenal	0.03	Aliphatic alcohol
para-Cymenene	0.08	Monoterpene
$\alpha$ -Thujone	0.01	Monoterpenic ketone
Linalool	0.04	Monoterpenic alcohol
Nonanal	0.01	Aliphatic aldehyde
endo-Fenchol	0.13	Monoterpenic alcohol

<i>cis</i> -para-Menth-2-en-1-ol	0.02	Monoterpenic alcohol
$\alpha$ -Campholenal	0.02	Monoterpenic aldehyde
Nopinone	0.02	Normonoterpenic ketone
<i>trans</i> -Pinocarveol	0.10	Monoterpenic alcohol
Camphor	0.18	Monoterpenic ketone
<i>trans</i> -para-Menth-2-en-1-ol	0.01	Monoterpenic alcohol
Camphene hydrate	0.06	Monoterpenic alcohol
meta-Mentha-4,6-dien-8-ol	0.01	Monoterpenic alcohol
Isoborneol	0.05	Monoterpenic alcohol
Pinocarvone	0.03	Monoterpenic ketone
Borneol	0.36	Monoterpenic alcohol
Isopinocampone	0.04	Monoterpenic ketone
$\alpha$ -Phellandren-8-ol	0.03	Monoterpenic alcohol
Terpinen-4-ol	0.21	Monoterpenic alcohol
Cryptone	0.02	Normonoterpenic ketone
para-Cymen-8-ol	0.01	Monoterpenic alcohol
$\alpha$ -Terpineol	0.84	Monoterpenic alcohol
Myrtenal	0.07	Monoterpenic aldehyde
Myrtenol	0.05	Monoterpenic alcohol
Methylchavicol	0.01	Phenylpropanoid
Unknown	0.01	Oxygenated monoterpene
Verbenone	0.05	Monoterpenic ketone
<i>trans</i> -Piperitol	0.01	Monoterpenic alcohol
endo-Fenchyl acetate	0.04	Monoterpenic ester
<i>trans</i> -Carveol	0.01	Monoterpenic alcohol
Thymol methyl ether	0.04	Monoterpenic ether
Citronellol	0.02	Monoterpenic alcohol
Carvone	0.02	Monoterpenic ketone
Piperitone	0.06	Monoterpenic ketone
Unknown	0.01	Unknown
Geraniol	0.01	Monoterpenic alcohol
Phellandral	0.03	Monoterpenic aldehyde
Isopulegyl acetate	0.02	Monoterpenic ester
Bornyl acetate	4.14	Monoterpenic ester
Isobornyl acetate	0.01	Monoterpenic ester
para-Cymen-7-ol	0.01	Monoterpenic alcohol
2-Undecanone	0.01	Aliphatic ketone
<i>trans</i> -Pinocarvyl acetate	0.01	Monoterpenic ester
Thymol	0.04	Monoterpenic alcohol
Myrtenyl acetate	0.01	Monoterpenic ester
$\alpha$ -Longipinene	0.09	Sesquiterpene
Unknown	0.01	Unknown
Citronellyl acetate	0.04	Monoterpenic ester
Longicyclene	0.03	Sesquiterpene
$\alpha$ -Ylangene	0.03	Sesquiterpene
$\alpha$ -Copaene	0.01	Sesquiterpene
Unknown	0.01	Unknown
$\beta$ -Bourbonene	0.02	Sesquiterpene
1,5-diepi- $\beta$ -Bourbonene	0.01	Sesquiterpene
Geranyl acetate	0.04	Monoterpenic ester
Sativene	0.01	Sesquiterpene
$\beta$ -Longipinene	0.02	Sesquiterpene

Longifolene	0.43	Sesquiterpene
Methyleugenol	tr	Phenylpropanoid
Amylphenol	0.02	Simple phenolic
$\beta$ -Caryophyllene	0.13	Sesquiterpene
$\beta$ -Copaene	0.01	Sesquiterpene
<i>trans</i> - $\alpha$ -Bergamotene	0.02	Sesquiterpene
$\alpha$ -Himachalene	0.02	Sesquiterpene
$\alpha$ -Humulene	0.07	Sesquiterpene
( <i>E</i> )- $\beta$ -Farnesene	0.03	Sesquiterpene
Thujopsene isomer	0.01	Sesquiterpene
$\gamma$ -Murolene	0.02	Sesquiterpene
Germacrene D	0.04	Sesquiterpene
$\gamma$ -Curcumene	0.03	Sesquiterpene
$\beta$ -Selinene	0.02	Sesquiterpene
Unknown	0.01	Unknown
$\alpha$ -Selinene	0.03	Sesquiterpene
$\beta$ -Himachalene	0.04	Sesquiterpene
$\alpha$ -Murolene	0.03	Sesquiterpene
( <i>Z</i> )- $\alpha$ -Bisabolene	0.03	Sesquiterpene
$\beta$ -Bisabolene	0.29	Sesquiterpene
$\gamma$ -Cadinene	0.01	Sesquiterpene
$\beta$ -Curcumene	0.02	Sesquiterpene
<i>trans</i> -Calamenene	0.02	Sesquiterpene
$\delta$ -Cadinene	0.04	Sesquiterpene
( <i>E</i> )- $\gamma$ -Bisabolene	0.03	Sesquiterpene
$\alpha$ -Calacorene	0.01	Sesquiterpene
( <i>E</i> )- $\alpha$ -Bisabolene	0.05	Sesquiterpene
( <i>E</i> )-Nerolidol	0.07	Sesquiterpenic alcohol
Caryophyllene oxide	0.03	Sesquiterpenic ether
Humulene epoxide II	0.01	Sesquiterpenic ether
Citronellyl caproate	0.01	Monoterpenic ester
Manoyl oxide	0.03	Diterpenic ether
18-Norabieta-8,11,13-triene?	0.03	Norditerpene
Abieta-8,12-diene	0.02	Diterpene
ar-Abietatriene	0.02	Diterpene
7,13-Abietadiene	0.02	Diterpene
( <i>Z</i> )-Abienol	0.10	Diterpenic alcohol
Palustral	0.02	Diterpenic aldehyde
Abietal	0.01	Diterpenic aldehyde
<b>Consolidated total</b>	<b>99.65%</b>	

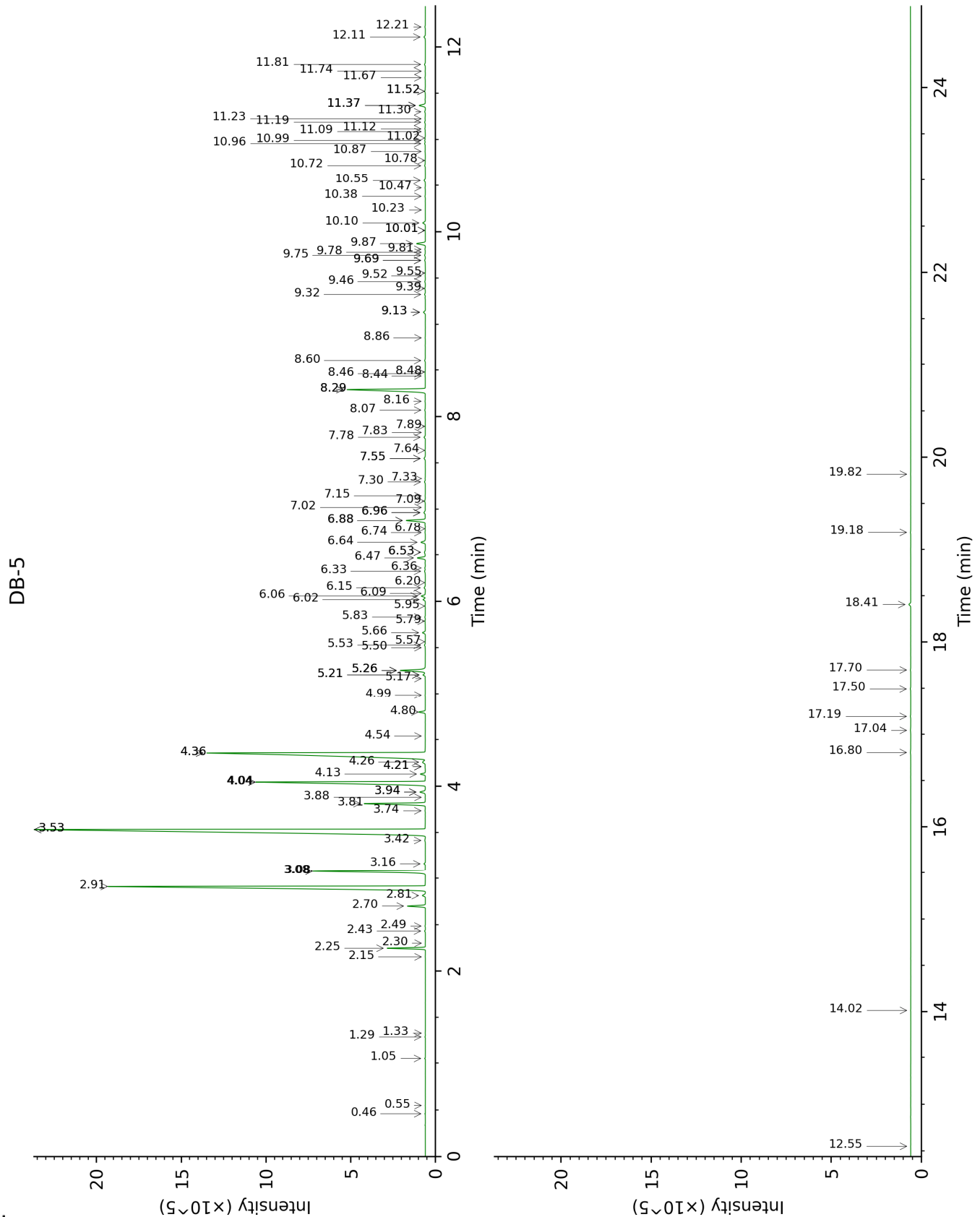
tr: The compound has been detected below 0.005% of total signal.

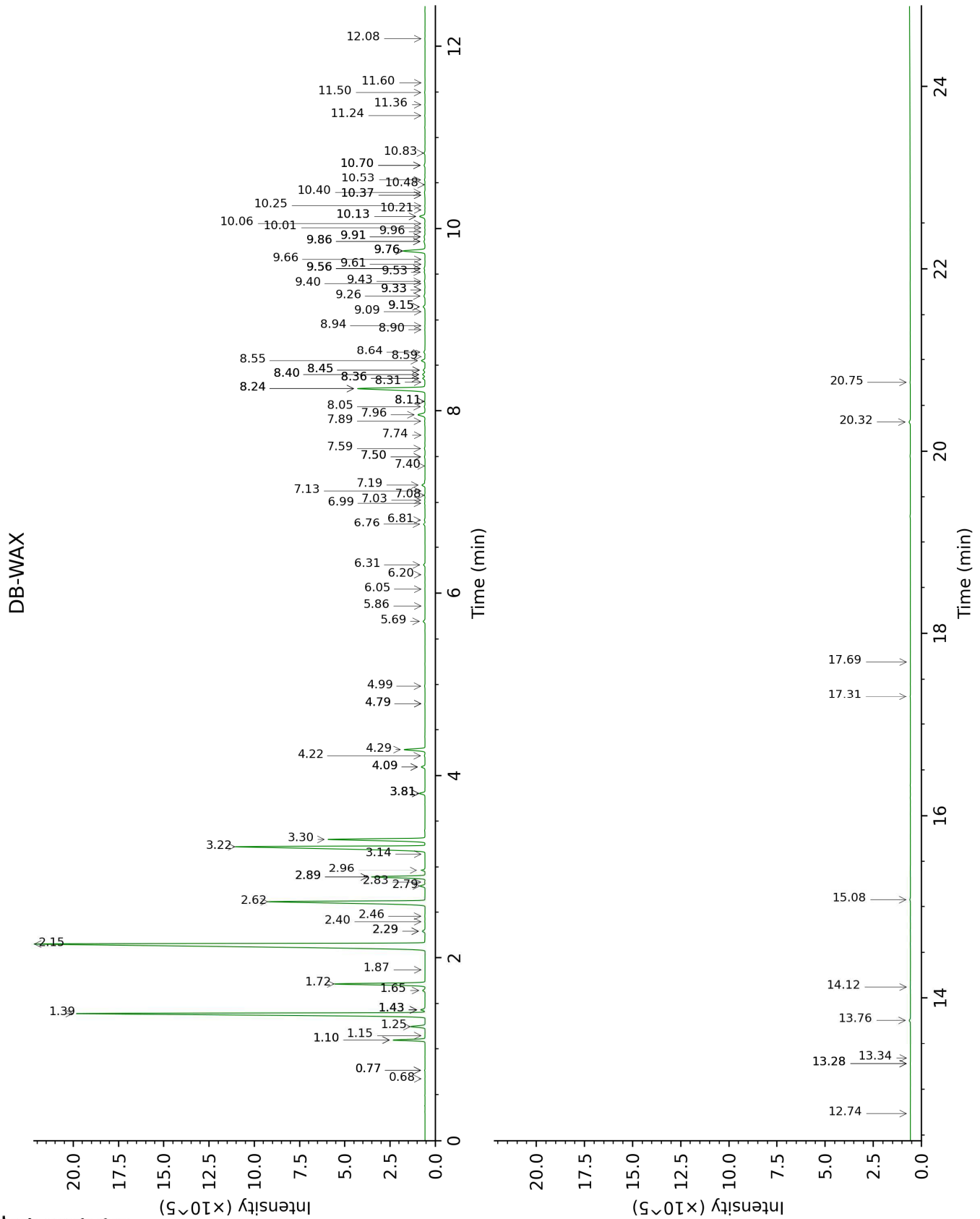
Note: no correction factor was applied

**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	%
3-Methylfuran	0.46	606	0.01	0.68	855	tr
Isovaleral	0.55	641	tr	0.77*	888	0.01
Toluene	1.05	758	0.02	1.43*	998	0.20
Unknown [m/z 56, 45 (99), 41 (24), 84 (24), 69 (19), 43 (17)...]	1.29	795	0.01	0.77*	888	[0.01]
Hexanal	1.33	801	0.01	1.87	1042	0.01
Unknown [m/z 79, 78 (45), 91 (28), 77 (28), 41 (13), 80 (12), 107 (11)... 122 (1)]	2.15	874	0.01	1.15	955	0.01
Santene	2.25	882	1.20	1.10*	947	1.21
Styrene	2.30	887	0.01	3.81*	1205	0.28
Unknown [m/z 79, 93 (66), 94 (52), 91 (39), 77 (37), 122 (31)]	2.43	899	0.03	1.43*	998	[0.20]
Bornylene	2.49	904	0.01	1.10*	947	[1.21]
Tricyclene	2.70	918	0.66	1.25	970	0.66
$\alpha$ -Thujene	2.81	926	0.14	1.43*	998	[0.20]
$\alpha$ -Pinene	2.91	933	19.39	1.39	994	19.37
Camphene	3.08*	944	4.54	1.72	1026	4.43
$\alpha$ -Fenchene	3.08*	944	[4.54]	1.64	1019	0.12
Thuja-2,4(10)-diene 3,7,7-	3.16	950	0.05	2.29*	1083	0.14
Trimethylcyclohepta-1,3,5-triene	3.42	967	0.04	2.89*	1133	2.50
$\beta$ -Pinene	3.53*	975	32.28	2.15	1069	32.22
Sabinene	3.53*	975	[32.28]	2.29*	1083	[0.14]
Unknown [m/z 91, 119 (65), 109 (51), 134 (47)]	3.74	988	0.02	3.14	1153	0.01
Myrcene	3.81	994	2.48	2.89*	1133	[2.50]
2-Carene	3.88	998	0.01	2.40	1094	0.01
$\alpha$ -Phellandrene	3.94*	1002	0.26	2.79	1125	0.23
Pseudolimonene	3.94*	1002	[0.26]	2.83	1128	0.02
(3Z)-Hexenyl acetate	4.04*	1009	9.24	4.79*	1278	0.01
$\Delta$ 3-Carene	4.04*	1009	[9.24]	2.62	1111	9.25
$\alpha$ -Terpinene	4.13	1015	0.20	2.96	1139	0.20
meta-Cymene	4.21*	1020	0.02	4.10*	1227	0.19
Carvomenthene	4.21*	1020	[0.02]	2.46	1099	0.02
para-Cymene	4.26	1023	0.19	4.10*	1227	[0.19]
Limonene	4.36*	1029	18.15	3.22	1159	13.18
$\beta$ -Phellandrene	4.36*	1029	[18.15]	3.30	1166	5.01
(Z)- $\beta$ -Ocimene	4.54	1041	0.01	3.81*	1205	[0.28]
$\gamma$ -Terpinene	4.80	1057	0.27	3.81*	1205	[0.28]
Unknown [m/z 79, 93 (60), 43 (40), 94 (35),	4.99	1069	0.01	4.79*	1278	[0.01]

137 (33), 77 (26), 91 (20), 152 (18)]						
meta-Cymenene	5.17	1080	0.01	6.20	1376	0.02
Isoterpinolene	5.21*	1083	0.11	4.22	1236	0.04
Fenchone	5.21*	1083	[0.11]	5.69	1340	0.10
Terpinolene	5.26*	1086	1.16	4.28	1241	1.05
γ-Campholenal	5.26*	1086	[1.16]	4.99	1293	0.03
para-Cymenene	5.26*	1086	[1.16]	6.31	1384	0.08
α-Thujone	5.50	1102	0.01	6.05	1365	0.01
Linalool	5.53	1103	0.04	8.05	1513	0.05
Nonanal	5.56	1106	0.01	5.86	1352	0.01
endo-Fenchol	5.66	1112	0.13	8.36*	1537	0.13
cis-para-Menth-2-en-1-ol	5.79	1120	0.02	8.10*	1518	0.04
α-Campholenal	5.83	1123	0.02	6.99	1434	0.02
Nopinone	5.95	1130	0.02	8.24*	1529	4.20
trans-Pinocarveol	6.02	1135	0.10	9.15*	1599	0.12
Camphor	6.06	1137	0.18	7.19	1449	0.18
trans-para-Menth-2-en-1-ol	6.09	1139	0.01	8.94	1582	0.01
Camphene hydrate	6.15	1143	0.06	8.45*	1544	0.11
meta-Mentha-4,6-dien-8-ol	6.20	1146	0.01	9.33*	1614	0.03
Isoborneol	6.32	1154	0.05	9.42	1621	0.04
Pinocarvone	6.36	1157	0.03	7.89	1501	0.02
Borneol	6.47	1164	0.36	9.76*	1648	1.28
Isopinocampone	6.53*	1168	0.06	7.59	1478	0.04
α-Phellandren-8-ol	6.53*	1168	[0.06]	10.13*	1679	0.35
Terpinen-4-ol	6.64	1174	0.21	8.55	1552	0.20
Cryptone	6.74	1181	0.02	9.15*	1599	[0.12]
para-Cymen-8-ol	6.78	1184	0.01	11.50	1794	0.02
α-Terpineol	6.88*	1190	0.91	9.76*	1648	[1.28]
Myrtenal	6.88*	1190	[0.91]	8.64	1560	0.07
Myrtenol	6.96*	1196	0.08	10.83	1737	0.05
Methylchavicol	6.96*	1196	[0.08]	9.33*	1614	[0.03]
Unknown [m/z 121, 43 (99), 91 (85), 77 (73), 93 (41), 136 (33)... 166 (3)]	7.02	1199	0.01			
Verbenone	7.09	1204	0.05	9.56*	1632	0.07
trans-Piperitol	7.15	1207	0.01	10.37*	1698	0.02
endo-Fenchyl acetate	7.30	1217	0.04	6.81	1420	0.04
trans-Carveol	7.33	1220	0.01	11.36	1782	0.01
Thymol methyl ether	7.55*	1234	0.07	8.45*	1544	[0.11]
Citronellol	7.55*	1234	[0.07]	10.70*	1726	0.06
Carvone	7.64	1240	0.02	10.01	1669	0.02
Piperitone	7.78	1250	0.06	9.91*	1661	0.07
Unknown [m/z 43, 97 (55), 107 (44), 41 (38), 109 (32), 55 (27)...]	7.83	1253	0.01			
Geraniol	7.90	1258	0.01	11.60	1803	0.01

Phellandral	8.07	1269	0.03	9.96	1665	0.02
Isopulegyl acetate	8.16	1276	0.02	8.10*	1518	[0.04]
Bornyl acetate	8.29*	1284	4.15	8.24*	1529	[4.20]
Isobornyl acetate	8.29*	1284	[4.15]	8.32	1534	0.01
para-Cymen-7-ol	8.44	1294	0.01	14.12	2033	0.01
2-Undecanone	8.46	1296	0.01	8.59	1556	0.01
<i>trans</i> -Pinocarvyl acetate	8.48	1297	0.01	9.09	1594	0.01
Thymol	8.60	1305	0.04	15.08	2126	0.03
Myrtenyl acetate	8.86	1323	0.01	9.61	1636	0.01
$\alpha$ -Longipinene	9.13*	1343	0.10	6.76	1417	0.09
Unknown [m/z 121, 93 (84), 43 (81), 79 (48), 117 (40), 56 (37)...]	9.13*	1343	[0.10]			
Citronellyl acetate	9.32	1356	0.04	9.53	1629	0.06
Longicyclene	9.39	1361	0.03	7.08	1441	0.02
$\alpha$ -Ylangene	9.46	1366	0.03	7.03	1437	0.02
$\alpha$ -Copaene	9.52	1370	0.01	7.13	1444	0.01
Unknown [m/z 93, 43 (59), 41 (40), 91 (40), 69 (33), 77 (22)...]	9.56	1373	0.01			
$\beta$ -Bourbonene	9.69*	1382	0.04	7.50*	1472	0.03
1,5-diepi- $\beta$ -Bourbonene	9.69*	1382	[0.04]	7.40	1464	0.01
Geranyl acetate	9.75	1386	0.04	10.53	1712	0.03
Sativene	9.78	1388	0.01	7.50*	1472	[0.03]
$\beta$ -Longipinene	9.81	1391	0.02	7.74	1489	0.01
Longifolene	9.87	1395	0.43	7.96	1506	0.45
Methyleugenol	10.01*	1405	0.02	13.28*	1954	0.01
Amylphenol	10.01*	1405	[0.02]			
$\beta$ -Caryophyllene	10.10	1411	0.13	8.40*	1540	0.14
$\beta$ -Copaene	10.24	1422	0.01	8.36*	1537	[0.13]
<i>trans</i> - $\alpha$ -Bergamotene	10.38	1433	0.02	8.40*	1540	[0.14]
$\alpha$ -Himachalene	10.48	1440	0.02	8.90	1579	0.02
$\alpha$ -Humulene	10.55	1446	0.07	9.26	1608	0.08
( <i>E</i> )- $\beta$ -Farnesene	10.72	1458	0.03	9.56*	1632	[0.07]
Thujopsene isomer	10.78	1462	0.01	9.40	1619	0.02
$\gamma$ -Muurolole	10.87	1469	0.02	9.56*	1632	[0.07]
Germacrene D	10.96	1476	0.04	9.76*	1648	[1.28]
$\gamma$ -Curcumene	10.99	1478	0.03	9.66	1641	0.01
$\beta$ -Selinene	11.02	1480	0.02	9.86*	1657	0.09
Unknown [m/z 43, 58 (75), 57 (58), 71 (55), 41 (41), 59 (31)...]	11.09	1485	0.01			
$\alpha$ -Selinene	11.12	1488	0.03	9.91*	1661	[0.07]
$\beta$ -Himachalene	11.19	1493	0.04	9.86*	1657	[0.09]
$\alpha$ -Muurolole	11.23	1496	0.03	10.06	1672	0.02
( <i>Z</i> )- $\alpha$ -Bisabolene	11.30	1501	0.03	10.21	1684	0.01
$\beta$ -Bisabolene	11.37*	1506	0.32	10.13*	1679	[0.35]
$\gamma$ -Cadinene	11.37*	1506	[0.32]	10.37*	1698	[0.02]

β-Curcumene	11.37*	1506	[0.32]	10.25	1688	0.02
<i>trans</i> -Calamenene	11.52*	1518	0.04	11.24	1772	0.02
δ-Cadinene	11.52*	1518	[0.04]	10.40	1700	0.04
( <i>E</i> )-γ-Bisabolene	11.67	1530	0.03	10.48	1707	0.02
α-Calacorene	11.74	1536	0.01	12.08	1846	0.01
( <i>E</i> )-α-Bisabolene	11.81	1541	0.05	10.70*	1726	[0.06]
( <i>E</i> )-Nerolidol	12.11	1564	0.07	13.76	1998	0.07
Caryophyllene oxide	12.22	1573	0.03	12.74	1904	0.01
Humulene epoxide II	12.55	1600	0.01	13.34	1959	0.01
Citronellyl caproate	14.02	1721	0.01	13.28*	1954	[0.01]
Manoyl oxide	16.80	1974	0.03			
18-Norabieta-8,11,13-triene?	17.04	1997	0.03			
Abieta-8,12-diene	17.19	2012	0.02			
ar-Abietatriene	17.50	2042	0.02	17.69	2400	0.01
7,13-Abietadiene	17.70	2062	0.02	17.31	2358	0.02
( <i>Z</i> )-Abienol	18.41	2134	0.10	20.32	2704	0.08
Palustral	19.18	2215	0.02	20.75	2758	0.02
Abietal	19.82	2284	0.01			
<b>Total identified</b>		<b>99.49%</b>			<b>99.43%</b>	
<b>Total reported</b>		<b>99.60%</b>			<b>99.45%</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