

## GC/MS BATCH NUMBER: MS0100

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**ESSENTIAL OIL:** MOLDAVIAN DRAGONHEAD  
**BOTANICAL NAME:** DRACOCEPHALUM MOLDAVICA  
**ORIGIN:** BULGARIA

KEY CONSTITUENTS PRESENT IN THIS BATCH OF MOLDAVIAN DRAGONHEAD OIL	%
GERANYL ACETATE	38.1
GERANIAL	21.1
NERAL	16.1
GERANIOL	6.2
NERYL ACETATE	3.7
NEROL	1.8
6-METHYL-5-HEPTEN-2-ONE	1.1

Comments from Robert Tisserand: Smells like a smooth, fragrant blend of Lemongrass and Palmarosa, with hints of candied orange and a white dessert wine. However this oil does not come from a grass, it's from a herb belonging to the Lamiaceae family.

Date : May 08, 2018

CERTIFICATE OF ANALYSIS - GC PROFILING

SAMPLE IDENTIFICATION

**Internal code :** 18E07-PTH1-1-CC

**Customer identification :** Moldavian Dragonhead - Bulgaria - MS010079R

**Type :** Essential oil

**Source :** *Dracocephalum moldavica*

**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 :** May 08, 2018

Checked and approved by :



Sylvain Mercier, M. Sc., chimiste 2014-005

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*This report is digitally signed, it is only considered valid if the digital signature is intact.*

*PHYSICOCHEMICAL DATA*

**Physical aspect:** Light yellow liquid

**Refractive index:**  $1.4728 \pm 0.0003$  (20 °C)

*CONCLUSION*

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

## ANALYSIS SUMMARY

Identification	DB-5 (%)	DB-WAX (%)	Classe
2-Methyl-3-buten-2-ol	0.01	0.02	Aliphatic alcohol
Isobutanol	tr	0.01	Aliphatic alcohol
Isovaleral	0.06	0.06	Aliphatic aldehyde
2-Methylbutyral	0.04	0.04	Aliphatic aldehyde
2-Ethylfuran	0.01	0.01*	Furan
Isoamyl alcohol	0.02	0.02	Aliphatic alcohol
2-Methylbutanol	0.02	0.02	Aliphatic alcohol
Hexanal	tr	tr	Aliphatic aldehyde
Octane	tr		Alkane
Butyric acid	0.01	0.02	Aliphatic acid
4-Methyl-3-hexanone	tr	tr	Aliphatic ketone
(Z)-Salvene	0.01*	[0.01]*	Normonoterpene
(2E)-Hexenal	[0.01]*	0.01	Aliphatic aldehyde
(3Z)-Hexenol	0.01	0.01	Aliphatic alcohol
Hexanol	tr	0.01	Aliphatic alcohol
Isoamyl acetate	0.01	0.01	Aliphatic ester
2-Methylbutyl acetate	tr	tr	Aliphatic ester
2-Methylbutyric acid	0.01	0.02	Aliphatic acid
Tricyclene	tr	tr	Monoterpene
$\alpha$ -Pinene	0.01	0.01	Monoterpene
Thuja-2,4(10)-diene	0.01	0.02	Monoterpene
Benzaldehyde	0.01	0.02	Simple phenolic
Octen-3-ol	0.27	0.29*	Aliphatic alcohol
Octan-3-one	1.35*	0.23*	Aliphatic ketone
6-Methyl-5-hepten-2-one	[1.35]*	1.11	Aliphatic ketone
<i>trans</i> -Dehydroxylinalool oxide	0.05*	0.01	Monoterpenic ether
Myrcene	[0.05]*	0.03	Monoterpene
6-Methyl-5-hepten-2-ol	0.02	0.01	Aliphatic alcohol
Octan-3-ol	0.08	0.08	Aliphatic alcohol
$\alpha$ -Phellandrene	0.03*	0.01*	Monoterpene
Octanal	[0.03]*	0.02	Aliphatic aldehyde
<i>cis</i> -Dehydroxylinalool oxide	0.01	0.01*	Monoterpenic ether
(3Z)-Hexenyl acetate	0.01	0.01	Aliphatic ester
(2E,4E)-3,7-Dimethylocta-2,4-diene?	0.03*	[0.01]*	Monoterpene
Limonene	[0.03]*	0.02	Monoterpene
$\beta$ -Phellandrene	[0.03]*	0.01	Monoterpene
Benzyl alcohol	0.04	0.02	Simple phenolic
(Z)- $\beta$ -Ocimene	0.02	0.02	Monoterpene
(E)- $\beta$ -Ocimene	0.03	[0.23]*	Monoterpene
2,6-Dimethyl-5-heptenal (melonal)	0.02	0.02	Aliphatic aldehyde
$\gamma$ -Terpinene	0.01	[0.01]*	Monoterpene
<i>cis</i> -Linalool oxide (fur.)	0.04	0.02	Monoterpenic alcohol
Unknown	0.02	0.03	Unknown
Terpinolene	0.03*	0.01	Monoterpene
<i>trans</i> -Linalool oxide (fur.)	[0.03]*	0.04	Monoterpenic alcohol
Rosefuran	0.12	0.12	Monoterpenic ether
Linalool	0.61	0.62	Monoterpenic alcohol
Unknown	0.04		Oxygenated monoterpene

<i>cis</i> -Chrysanthemal?	0.01	tr	Monoterpenic aldehyde
( <i>Z</i> )-6-Methyl-3,5-heptadien-2-one	0.01	0.04	Aliphatic ketone
Octen-3-yl acetate	0.06	0.06	Aliphatic ester
Unknown	0.02	0.02	Unknown
Octan-3-yl acetate	0.01	0.01	Aliphatic ester
Unknown	0.27		Unknown
exo-Isocitral	0.54*	0.11	Monoterpenic aldehyde
<i>trans</i> -Chrysanthemal	[0.54]*	0.45	Monoterpenic aldehyde
Unknown	0.02	[0.29]*	Unknown
Citronellal	0.40*	0.20	Monoterpenic aldehyde
Nerol oxide	[0.40]*	0.18	Aliphatic ether
Isoneral	0.58	0.48	Monoterpenic aldehyde
$\alpha$ -Cyclogeraniol?	0.26		Monoterpenic alcohol
Rosefuran oxide	0.10	0.05	Monoterpenic ether
Isogeraniol	0.95	0.82	Monoterpenic aldehyde
$\alpha$ -Terpineol	0.10	0.52*	Monoterpenic alcohol
Unknown	0.06		Unknown
Methyl salicylate	0.02		Phenolic ester
Unknown	0.28		Oxygenated monoterpene
Decanal	0.05	0.06	Aliphatic aldehyde
2,3-Epoxyneral?	0.07		Monoterpenic aldehyde
Nerol	1.83	1.86	Monoterpenic alcohol
2,3-Epoxygeraniol?	0.14		Monoterpenic aldehyde
Neral	16.14	16.10	Monoterpenic aldehyde
Piperitone	0.06	0.10*	Monoterpenic ketone
Geraniol	6.18*	6.20	Monoterpenic alcohol
Linalyl acetate	[6.18]*	0.03	Monoterpenic ester
Geranial	21.09	21.20	Monoterpenic aldehyde
Dihydroedulan I	0.03	0.03	Terpenic ether
Geranyl formate	0.06	[0.10]*	Monoterpenic ester
Methyl geranate	0.32	0.36	Monoterpenic ester
Terpinyl acetate analog	0.03	0.03	Monoterpenic ester
Neric acid	0.12	0.11	Monoterpenic acid
Neryl acetate	3.66	3.63	Monoterpenic ester
$\alpha$ -Copaene	0.48	0.13	Sesquiterpene
Geranic acid	[0.48]	0.42*	Aliphatic acid
Geranyl acetate	38.14	38.21	Monoterpenic ester
$\beta$ -Caryophyllene	0.63	0.64	Sesquiterpene
$\beta$ -Copaene	0.03	0.03	Sesquiterpene
Isogermacrene D	0.02	0.01	Sesquiterpene
$\alpha$ -Humulene	0.07	0.10	Sesquiterpene
Unknown	0.03		Unknown
Germacrene D	0.48	[0.52]*	Sesquiterpene
Bicyclogermacrene	0.14*	0.27*	Sesquiterpene
Unknown	[0.14]*		Unknown
$\alpha$ -Muurolene	0.03	[0.27]*	Sesquiterpene
(3 <i>E</i> ,6 <i>E</i> )- $\alpha$ -Farnesene	0.13*		Sesquiterpene
$\gamma$ -Cadinene	[0.13]*	0.09	Sesquiterpene
$\delta$ -Cadinene	0.13	0.14	Sesquiterpene
Spathulenol	0.02	0.03	Sesquiterpenic alcohol
Caryophyllene oxide	0.29*	0.24	Sesquiterpenic ether
Caryophyllene oxide isomer	[0.29]*	0.06	Sesquiterpenic ether

Humulene epoxide II	0.03	0.04	Sesquiterpenic ether
10-epi-Cubenol	0.03		Sesquiterpenic alcohol
$\tau$ -Muurolol	0.04*	0.03	Sesquiterpenic alcohol
$\tau$ -Cadinol	[0.04]*	0.02	Sesquiterpenic alcohol
$\alpha$ -Muurolol	0.02	0.01	Sesquiterpenic alcohol
$\alpha$ -Cadinol	0.05	0.06	Sesquiterpenic alcohol
Mint sulfide?	0.01		Sesquiterpenic sulfide
Phytone	0.03	0.03	Terpenic ketone
Dicitral	0.05	[0.42]*	Aliphatic alcohol
Unknown	0.03		Unknown
<b>Total identified</b>	<b>96.68%</b>	<b>96.20%</b>	

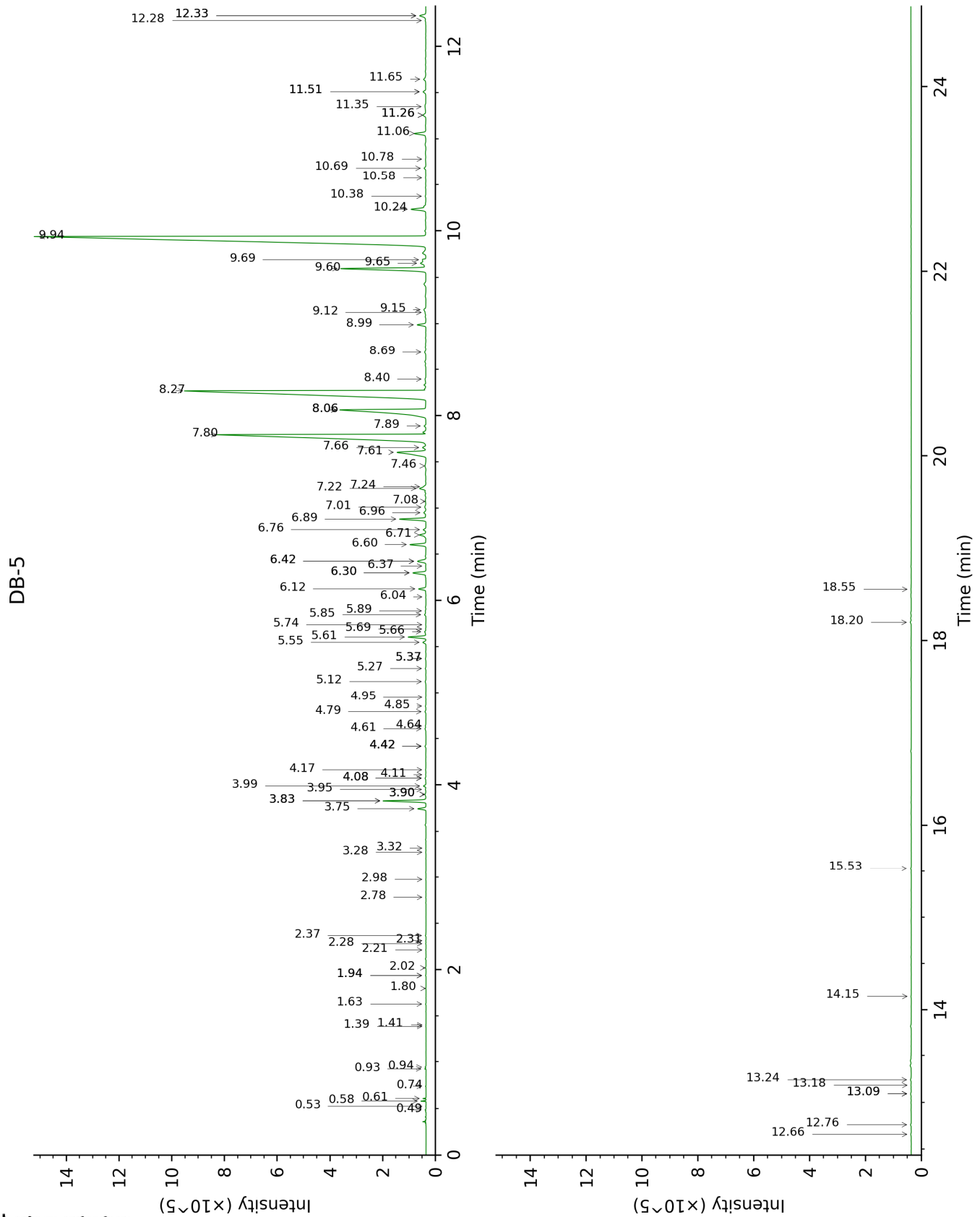
\*: Two or more compounds are coeluting on this column

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

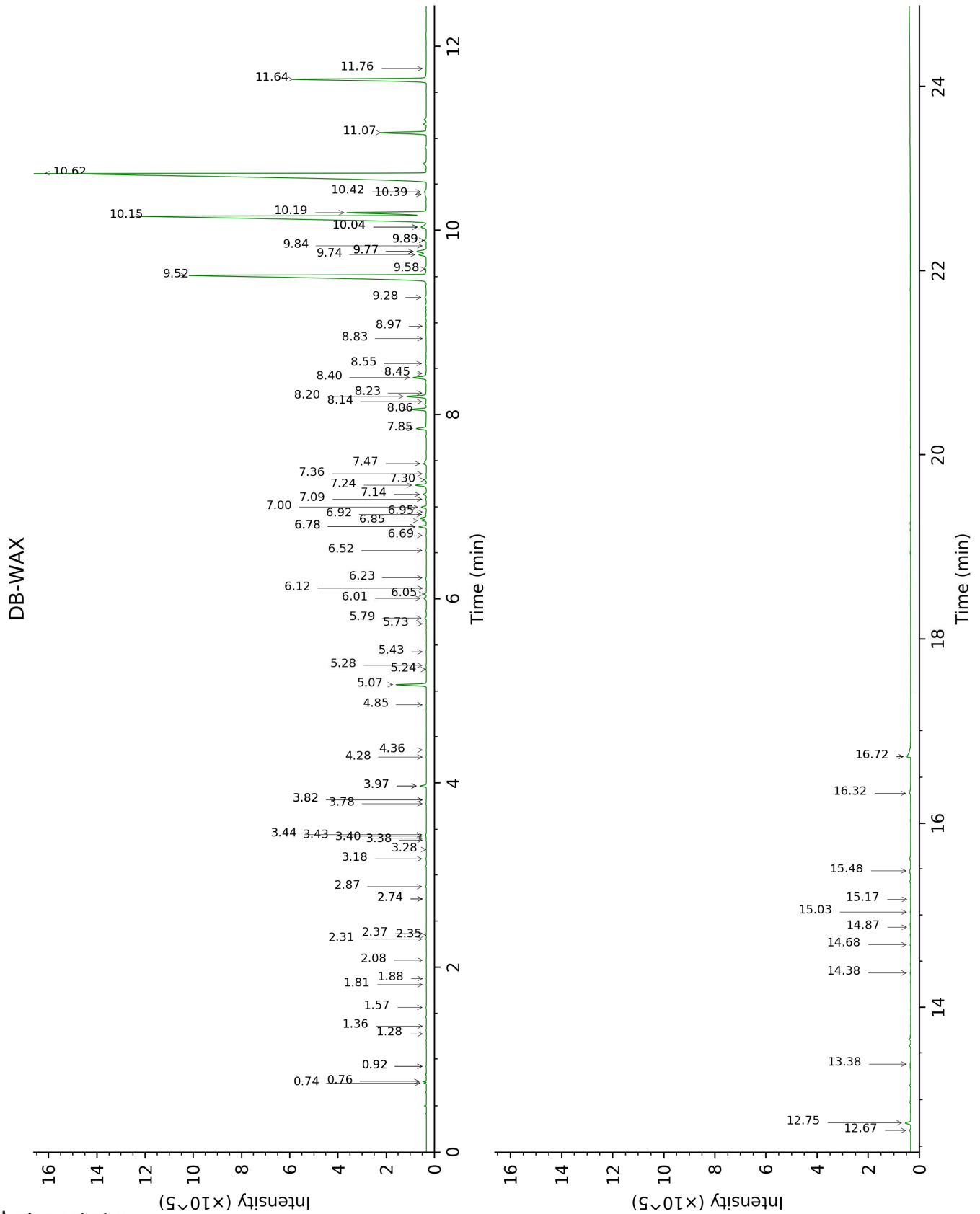
tr: The compound has been detected below 0.005% of total signal.

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	%
2-Methyl-3-buten-2-ol	0.49	604	0.01	1.57	1015	0.02
Isobutanol	0.52	617	tr	2.08	1066	0.01
Isovaleral	0.58	637	0.06	0.76	885	0.06
2-Methylbutyral	0.61	647	0.04	0.74	878	0.04
2-Ethylfuran	0.74	693	0.01	0.92*	919	0.01
Isoamyl alcohol	0.93	725	0.02	3.44	1178	0.02
2-Methylbutanol	0.94	728	0.02	3.43	1177	0.02
Hexanal	1.39	794	tr	1.88	1046	tr
Octane	1.41	796	tr			
Butyric acid	1.63	818	0.01	8.83	1575	0.02
4-Methyl-3-hexanone	1.80	832	tr	1.81	1039	tr
(Z)-Salvene	1.94*	844	0.01	0.92*	919	[0.01]
(2E)-Hexenal	1.94*	844	[0.01]	3.40	1175	0.01
(3Z)-Hexenol	2.02	851	0.01	5.73	1344	0.01
Hexanol	2.21	868	tr	5.43	1322	0.01
Isoamyl acetate	2.28	874	0.01	2.36	1094	0.01
2-Methylbutyl acetate	2.31	876	tr	2.35	1092	tr
2-Methylbutyric acid	2.37	881	0.01	9.84	1655	0.02
Tricyclene	2.78	913	tr	1.28	978	tr
α-Pinene	2.98	926	0.01	1.36	992	0.01
Thuja-2,4(10)-diene	3.28	946	0.01	2.31	1088	0.02
Benzaldehyde	3.32	949	0.01	7.36	1463	0.02
Octen-3-ol	3.75	978	0.27	6.78*	1420	0.29
Octan-3-one	3.83*	984	1.35	3.97*	1217	0.23
6-Methyl-5-hepten-2-one	3.83*	984	[1.35]	5.07	1295	1.11
<i>trans</i> -Dehydroxylinalool oxide	3.90*	988	0.05	3.38	1174	0.01
Myrcene	3.90*	988	[0.05]	2.87	1134	0.03
6-Methyl-5-hepten-2-ol	3.95	992	0.02	6.95	1432	0.01
Octan-3-ol	3.99	995	0.08	6.05	1367	0.08
α-Phellandrene	4.08*	1000	0.03	2.74*	1124	0.01
Octanal	4.08*	1000	[0.03]	4.36	1245	0.02
<i>cis</i> -Dehydroxylinalool oxide	4.11	1003	0.01	3.82*	1207	0.01
(3Z)-Hexenyl acetate	4.17	1006	0.01	4.85	1279	0.01
(2E,4E)-3,7-Dimethylocta-2,4-diene?	4.42*	1022	0.03	2.74*	1124	[0.01]

Limonene	4.42*	1022	[0.03]	3.18	1158	0.02
β-Phellandrene	4.42*	1022	[0.03]	3.28	1166	0.01
Benzyl alcohol	4.61	1034	0.04	11.76	1818	0.02
(Z)-β-Ocimene	4.64	1036	0.02	3.78	1204	0.02
(E)-β-Ocimene	4.79	1046	0.03	3.97*	1217	[0.23]
2,6-Dimethyl-5-heptenal (melonal)	4.85	1050	0.02	5.28	1312	0.02
γ-Terpinene	4.95	1056	0.01	3.82*	1207	[0.01]
cis-Linalool oxide (fur.)	5.12	1067	0.04	6.52	1401	0.02
Unknown [m/z 43, 84 (59), 41 (20), 59 (18)...]	5.27	1076	0.02	6.69	1413	0.03
Terpinolene	5.37*	1082	0.03	4.28	1239	0.01
trans-Linalool oxide (fur.)	5.37*	1082	[0.03]	6.92	1430	0.04
Rosefuran	5.55	1094	0.12	6.01	1363	0.12
Linalool	5.61	1097	0.61	8.06	1515	0.62
Unknown [m/z 41, 81 (97), 69 (91), 55 (68), 123 (65), 83 (64), 109 (56)... 152 (3)]	5.66	1101	0.04			
cis-Chrysanthemal?	5.69	1103	0.01	6.12	1371	tr
(Z)-6-Methyl-3,5-heptadien-2-one	5.74	1106	0.01	8.24	1529	0.04
Octen-3-yl acetate	5.85	1113	0.06	5.79	1348	0.06
Unknown [m/z 81, 79 (19), 41 (12), 92 (8), 77 (8)...]	5.89	1115	0.02	6.23	1379	0.02
Octan-3-yl acetate	6.04	1125	0.01	5.24	1308	0.01
Unknown [m/z 95, 67 (86), 41 (68), 82 (64), 123 (62)...]	6.12	1131	0.27			
exo-Isocitral	6.30*	1142	0.54	7.47	1471	0.11
trans-Chrysanthemal	6.30*	1142	[0.54]	7.24	1454	0.45
Unknown [m/z 137, 67 (13), 95 (13), 81 (13)... 152 (6)]	6.37	1146	0.02	6.78*	1420	[0.29]
Citronellal	6.42*	1150	0.40	7.00	1436	0.20
Nerol oxide	6.42*	1150	[0.40]	6.85	1425	0.18
Isoneral	6.60	1161	0.58	7.85	1499	0.48
α-Cyclogeraniol?	6.71	1168	0.26			
Rosefuran oxide	6.76	1172	0.10	8.55	1554	0.05
Isogeraniol	6.89	1180	0.95	8.20	1526	0.82
α-Terpineol	6.96	1184	0.10	9.77*	1650	0.52
Unknown [m/z 43, 81 (47), 67 (45), 69 (944), 41 (42), 59	7.01	1188	0.06			

(40), 55 (39)...						
Methyl salicylate	7.08	1192	0.02			
Unknown [m/z 123, 81 (40), 67 (29), 79 (29), 93 (26), 121 (25), 41 (24), 55 (18), 69 (15)...	7.22	1201	0.28			
Decanal	7.24	1202	0.05	7.30	1458	0.06
2,3-Epoxyneral?	7.46	1217	0.07			
Nerol	7.61	1227	1.83	11.07	1758	1.86
2,3-Epoxygeranial?	7.66	1230	0.14			
Neral	7.80	1240	16.14	9.52	1630	16.10
Piperitone	7.89	1246	0.06	9.89*	1660	0.10
Geraniol	8.06*	1258	6.18	11.64	1807	6.20
Linalyl acetate	8.06*	1258	[6.18]	8.14	1522	0.03
Geranial	8.27	1272	21.09	10.16	1681	21.20
Dihydroedulan I	8.40	1280	0.03	7.09	1442	0.03
Geranyl formate	8.69	1300	0.06	9.89*	1660	[0.10]
Methyl geranate	8.99	1321	0.32	9.74	1648	0.36
Terpinyl acetate analog	9.12	1330	0.03	9.58	1635	0.03
Neric acid	9.15	1333	0.12	16.32	2255	0.11
Neryl acetate	9.60	1364	3.66	10.19	1684	3.63
$\alpha$ -Copaene	9.65†	1368	0.48	7.14	1446	0.13
Geranic acid	9.69†	1371	[0.48]	16.72*	2296	0.42
Geranyl acetate	9.94	1388	38.14	10.62	1720	38.21
$\beta$ -Caryophyllene	10.24	1410	0.63	8.40	1542	0.64
$\beta$ -Copaene	10.38	1420	0.03	8.45	1545	0.03
Isogermacrene D	10.58	1435	0.02	8.97	1586	0.01
$\alpha$ -Humulene	10.68	1443	0.07	9.28	1610	0.10
Unknown [m/z 57, 71 (92), 43 (69), 85 (49), 41 (31), 55 (23)...	10.78	1451	0.03			
Germacrene D	11.06	1472	0.48	9.77*	1650	[0.52]
Bicyclogermacrene	11.26*	1486	0.14	10.04*	1672	0.27
Unknown [m/z 43, 85 (60), 81 (49), 71 (49), 79 (47), 59 (42), 84 (35)...	11.26*	1486	[0.14]			
$\alpha$ -Muurolene	11.35	1493	0.03	10.04*	1672	[0.27]
(3E,6E)- $\alpha$ -Farnesene	11.51*	1505	0.13			
$\gamma$ -Cadinene	11.51*	1505	[0.13]	10.39	1701	0.09
$\delta$ -Cadinene	11.65	1516	0.13	10.42	1703	0.14
Spathulenol	12.28	1566	0.02	14.38	2059	0.03
Caryophyllene oxide	12.33*	1570	0.29	12.75	1906	0.24
Caryophyllene oxide isomer	12.33*	1570	[0.29]	12.67	1898	0.06
Humulene	12.66	1596	0.03	13.38	1964	0.04

epoxide II						
10-epi-Cubenol	12.76	1604	0.03			
τ-Muurolol	13.09*	1632	0.04	15.03	2123	0.03
τ-Cadinol	13.09*	1632	[0.04]	14.87	2107	0.02
α-Muurolol	13.18	1639	0.02	15.17	2137	0.01
α-Cadinol	13.24	1644	0.05	15.48	2168	0.06
Mint sulfide?	14.15	1720	0.01			
Phytone	15.53	1842	0.03	14.68	2088	0.03
Dicitral	18.20	2098	0.05	16.72*	2296	[0.42]
Unknown [m/z 69, 41 (38), 151 (36), 123 (34), 82 (24), 43 (23), 109 (21)...]	18.56	2135	0.03			
<b>Total identified</b>		<b>96.68%</b>			<b>96.20%</b>	
<b>Total reported</b>		<b>97.46%</b>			<b>96.24%</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