INFLUENCE OF DRYING METHODS ON CHEMICAL COMPOSITION OF THE ESSENTIAL OIL OF *Glechoma longituba*

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Leaves of aromatic plants are often dried before extraction to reduce moisture content. A literature search was undertaken on effects of different methods of drying on the chemical composition of essential oil plants. Results show that the drying method had a significant effect on oil compositions, physical properties, and antioxidant activities of aromatic plants [1–3]. The aim of our study was to investigate the essential oil of leaves of *G. longituba* and test the effect of different drying methods (sun-drying, shade-drying, oven-drying at 45°C, and silica gel-drying) on the quality of essential oil.

The chemical compositions of the oils obtained by the four drying methods differed significantly. The percentage compositions of the essential oils are listed in Table 1 along with the retention indices of the identified compounds. As shown, all the essential oils were complex mixtures. A comparison of the compositions of the essential oils during the mentioned drying methods revealed both quantitative and qualitative differences. In total, 92, 46, 77, 63, and 81 constituents were identified and quantified in the oven-dried, sun-dried, shade-dried, silica gel-dried, and fresh leaves. Twenty-two compounds were common in all of the samples and represented from the lowest amount in the oven-dried leaves (46.3%) to the highest level in the silica gel-dried leaves (62.1%). Classification of the identified compounds based on functional groups is also summarized. As can be seen, sesquiterpene was shown to be the main group of constituents of all of the samples ranging from 17.3% to 52.8%.

Different drying methods caused some variation of the relative proportions of the components. Results show that a higher amount of germacrene D (19.0%) was obtained by shade-drying. Only sun drying brought about significant losses of the major compounds (α-cadinol, germacrene B, germacrene D-4-ol, and α-caryophyllene) in the essential oil when compared to the fresh plant material. The changes in the concentrations of the volatile compounds during drying depend on several factors, such as the drying method and the class of plant. *G. longituba* belongs to the Lamiaceae family of plants, which are known to store their essential oils on or near the leaf surfaces [4].This might account for the loss of volatile compounds in *G. longituba* leaves when sun-dried.

In this study, it may be suggested that α-cadinol, germacrene B, germacrene D-4-ol, α-caryophyllene, and some minor components, which were observed in the oven-dried, shade-dried, and silica gel-dried oils, were vaporized or converted to other compounds in the sun-dried leaf oil.

Comparison of the results shows that the different drying methods had a significant effect on the percentage of main components. Finally, it could be concluded that drying of leaves of *G. longituba* under normal air and at room temperature conditions is most suitable for a high-percentage of sesquiterpene, especially for germacrene D, but the oven-drying and silica gel-drying method are recommended for fast drying and similar components compared to the fresh plant material.

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TABLE 1. Chemical and Compound-Class Compositions of the Essential Oil from *G. longituba* Leaves using Different Drying Methods [5]

Compound	RI	Plant material (leaves), %				
		Fresh	Oven dried	Sun dried	Shade dried	Silica gel dried
Leaf Aldehyde	814	1.8	0.1	-	0.1	0.8
trans-2-Hexen-1-ol	868	0.1	0.1	-	-	0.2
Ethylbenzene	893	0.1	0.1	0.7	0.2	0.5
(+)-Sabinene	897	0.8	2.3	-	0.2	-
α-Thujene	902	-	0.1	-	-	0.1
m-Xylene	907	0.5	0.6	2.7	0.8	1.7
o-Xylene	907	0.1	0.1	0.1	0.1	0.6
(+)-4-Carene	919	0.5	0.6	-	0.3	0.1
Camphene	943	0.1	0.7	1.9	0.1	-
α-Pinene	948	0.2	0.4	0.7	0.1	-
3-Octanone	952	0.3	0.7	-	0.4	1.7
Myrcene	958	0.1	0.4	-	0.1	0.2
Oct-1-en-3-ol	969	1.7	1.7	-	1.8	9.4
β-*trans*-Ocimene	976	0.4	0.2	-	0.2	-
β-*cis*-Ocimene	976	1.0	2.3	0.3	0.8	0.4
Octan-3-ol	979	0.1	0.1	-	0.1	0.9
γ-Terpinene	998	0.2	4.1	-	0.8	0.1
Limonene	1018	0.6	3.4	-	0.7	-
Isoborneol	1038	-	-	-	0.8	1.0
5-Isopropyl-2-methylbicyclo[3.1.0]hexan-2-ol	1041	0.1	0.1	-	-	0.1
o-Cymene	1042	0.1	0.6	-	0.2	-
α-Terpinolene	1052	-	0.7	-	-	-
Eucalyptol	1059	1.5	10.1	0.7	4.4	10.3
β-Linalool	1082	0.1	0.1	-	0.1	-
Z,*Z*-2,6-Dimethyl-3,5,7-octatrien-2-ol	1090	-	-	-	-	0.3
n-Nonanal	1104	-	-	-	0.1	-
n-Undecane	1115	0.1	0.1	-	-	0.1
(±)-Camphor	1121	0.1	0.1	-	0.1	-
4-Terpineol	1137	0.7	0.4	-	0.4	0.2
Borneol	1138	1.6	0.4	-	-	-
α-Terpineol	1143	0.1	0.2	-	0.2	0.2
6-Ethyl-2-methyldecane	1185	-	-	-	0.1	0.2
α-Santalene	1211	-	-	-	0.9	0.4
Copaene	1221	0.3	0.1	-	0.2	-
5-Butylnonane	1249			3.2	-	0.2
Thymol	1262	-	2.9	-	3.0	0.2
Carvacrol	1262	0.1	0.7	-	0.7	-
Bornyl acetate	1277	2.0	0.5	1.1	2.3	1.8
4,6-Dimethyldodecane	1285			2.6	-	0.2
n-Tridecane	1313	0.1	0.1	0.4	-	-
Farnesane	1320	0.1	0.2	0.6	-	-
cis-Jasmone	1338	0.1	0.1	-	0.1	-
β-Cubebene	1339	0.1	0.1	-	-	-
α-Cubebene	1344	0.1	0.1	-	-	0.1
5-Methyltridecane	1349	-	0.1	0.3	-	0.1
β-Elemene	1398	1.4	0.0	-	1.9	1.2
Copaene	1413	-	0.8	4.3	0.9	-
α-Bergamotene	1430	-	-	-	0.2	-
γ-Elixene	1431	0.4	0.1	-	0.1	2.4
γ-Muurolene	1435	2.2	0.2	-	0.2	-
γ-Cadinene	1435	0.4	0.1	-	0.9	0.5
2-Bromododecane	1446	0.1	0.1	-	-	0.1
3-Methyltetradecane	1448	0.2	0.2	2.9	-	-
α-Farnesene	1458	0.9	0.2	-	-	-
γ-Elemene	1465	1.4	0.1	-	0.7	-
δ-Cadinene	1469	2.0	1.1	2.0	2.2	1.5

TABLE 1. (continued)

Compound	RI	Plant material (leaves), %				
		Fresh	Oven dried	Sun dried	Shade dried	Silica gel dried
α-Selinene	1474	-	-	-	0.3	-
β-Caryophyllene	1494	2.1	1.5	1.0	2.6	1.3
Caryophyllene oxide	1507	0.7	0.1	-	2.1	1.7
n-Pentadecane	1512	5.5	1.2	12.9	2.6	4.1
Germacrene D	1515	5.8	6.9	4.5	19.0	11.2
β-Himachalene	1528	-	-	-	2.1	1.0
(-)-Spathulenol	1536	0.5	0.2	3.2	1.4	2.3
4-Methylpentadecane	1548	0.7	0.4	5.2	0.1	0.8
(+)-Cuparene	1556	-	-	-	0.9	0.4
DPA	1566	1.5	1.5	5.6	2.1	6.1
α-Caryophyllene	1579	5.3	1.4	2.2	3.3	1.9
α-Cadinol	1580	10.1	6.4	2.3	7.6	8.2
(-)-Cedreanol	1580	0.7	0.4	-	0.6	0.6
Selina-6-en-4-ol	1593	1.1	0.1	-	0.6	1.0
Tetradecanal	1601	0.2	0.1	-	0.1	-
Germacrene B	1603	5.0	3.0	-	4.3	-
4-Cyclohexyldecane	1611	-	0.1	-	-	-
n-Hexadecane	1612	-	1.3	1.7	-	-
2,6,10-Trimethylpentadecane	1618	0.3	0.1	3.1	0.1	0.2
α-Bisabolol	1625	0.4	-	-	0.2	-
2-Methylhexadecane	1647	0.2	0.1	1.1	-	0.2
Pristane	1653	0.9	0.2	2.6	-	-
Germacrene D-4-ol	1660	4.2	2.8	1.0	3.5	3.3
4-Cyclohexylundecane	1710	0.8	-	-	0.1	-
n-Heptadecane	1711	1.0	0.6	4.9	0.4	1.1
Phytane	1753	0.1	0.1	-	-	-
(-)-Phyllocladene	1789	-	0.1	-	0.1	-
n-Octadecane	1810	0.8	0.4	3.2	0.2	1.3
5-Methyloctadecane	1846	-	-	-	-	0.3
2-Decyl-3-(5-methylhexyl)oxirane	1898			0.7	-	-
Phthalic acid, diisobutyl ester	1908	-	0.1	0.3	0.1	-
(1-Propyldecyl)cyclohexane	1909			3.4	-	0.2
Rimuene	1926	-	1.0	-	-	-
10-Methylnonadecane	1945	-	0.1	1.6	-	-
4a, *trans*-4b,*cis*-8a, *trans*-10a-Perhydro-*cis*-2,4b,8,8-tetramethyl-*trans*-2,10a-ethanophenanthren-11-one	1967			-	6.0	-
n-Hexadecanoic acid	1968	0.6	0.6	0.4	0.6	0.4
Phthalic acid, butyl isobutyl ester	1973	-	-	-	0.2	-
7-Isopropyl-1,1,4a-trimethyl-1,2,3,4,4a,9,10,10a-octahydrophenanthrene	2004	-	-	-	0.2	0.1
Eicosane	2009	-	-	-	0.4	-
2-Butyloxycarbonyloxy-1,1,10-trimethyl-6,9-epidioxydecalin	2021	-	-	-	-	2.1
n-Octadecyl chloride	2036	-	0.7	0.3	-	-
Dibutyl phthalate	2037	0.1	0.1	-	-	-
8-Hexylpentadecane	2045	0.3	0.1	1.3	0.1	-
Thunbergene	2072	-	1.8	-	1.0	-
(9*E*,12*E*,15*E*)-9,12,15-Octadecatrien-1-ol	2077	-	-	-	0.9	-
Linoleic acid, methyl ester	2093	0.4	0.1	-	-	-
Linolenic acid, methyl ester	2101	0.8	0.1	-	-	-
n-Heneicosane	2109	3.2	0.1	-	0.1	5.6
5α-Androstane-3,11-dione	2112	8.4	6.4	6.3	-	-
Kaura-5,16-dien-18 (or 19)-ol, acetate	2166	-	3.8	-	-	-
cis,*cis*-Linoleic acid	2183	-	0.1	-	-	-
n-Docosane	2208	4.4	-	-	-	1.2
Thunbergol	2211	0.9	6.5	0.7	3.5	1.0

TABLE 1. (continued)

Compound	RI	Plant material (leaves), %				
		Fresh	Oven dried	Sun dried	Shade dried	Silica gel dried
Phthalic acid, butyl cyclohexyl ester	2299	-	-	0.3	-	-
cis-8,11,14-Eicosatrienoic acid	2390	1.0	0.1	-	-	-
n-Tetracosane	2407	-	-	-	-	0.9
7-Oxodehydroabietic acid, methyl ester	2442	1.0	0.1	-	1.0	-
n-Octadecyl chloride	2542	-	0.2	-	-	-
2-Cyclohexyleicosane	2605			1.6	-	-
Butyl decyl phthalate	2633	0.1	0.1	0.1	-	-
Sulfurous acid, octadecyl 2-propyl ester	2668	-	0.1	-	-	-
Oxalic acid, hexadecyl isohexyl ester	2677			0.9	-	-
n-Nonacosane	2904	2.0	0.6	2.2	0.4	1.6
trans-Squalene	2914	1.0	-	-	-	0.2
3,17-Diacetoxy-1-phenylthioandrostane	3310	-	9.2	-	1.9	-
11-*n*-Decyltetracosane	3337	0.1	-	-	-	-
n-Tetratriacontane	3401	1.5	-	0.6	0.2	-
n-Hexatriacontane	3600	-	-	-	-	0.6
Monoterpene		8.2	25.8	3.6	15.1	14.7
Sesquiterpene		43.5	25.7	17.3	52.8	35.7
Diterpene		0.9	9.3	0.7	4.5	1.0
Others		46.0	38.8	78.1	26.0	47.3
Total		98.6	99.6	99.7	98.4	98.7

RI: Retention indices on RTX-5 capillary column.

%: Calculated from TIC data.

REFERENCES

1. R. Omidbaigi, F. Sefidkon, and F. Kazemi, *Flav. Frag. J.*, **19**, 196 (2004).
2. C. L. Hsua, W. L. Chenb, Y. M. Wenga, and C. Y. Tsenga, *Food Chem.*, **83**, 85 (2003).
3. F. Sefidkon, K. Abbasi, and G. B. Khaniki, *Food Chem.*, **99**, 19 (2006).
4. D. A. Moyler, *Spices–Recent Advances*, in: G. Charalambous (Ed.), *Spices, Herbs and Edible Fungi*, Amsterdam, 1994.
5. R. P. Adams, *Identification of Essential Oil Components by Gas Chromatography/Quadrupole Mass Spectroscopy*, Allured Publishing Co., Illinois, USA, 1995.