Turkish Journal of Agriculture - Food Science and Technology, 10(6): 1108-1111, 2022
DOI: https://doi.org/10.24925/turjaf.v10i6.1108-1111.5165

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

Chemical Constituents of Essential oil of *Syringa vulgaris* L. flowers

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ARTICLE INFO

Research Article

Received : 13/03/2022
Accepted : 27/03/2022

Keywords:
Natural products
Essential oil
Hydrodistillation
Chemical constituents
GC/MS/MS analysis

ABSTRACT

Medicinal plants gain a great interest in drug development process due to their bioactive compounds content. *Syringa vulgaris* L. has been used as traditional medicine and it has considerable biological effects. In this study, essential oil (EO) was generated from *Syringa vulgaris* L. flowers by hydrodistillation and the chemical constituents were identified by GC/MS/MS analysis. The GC/MS/MS analysis revealed the presence of 57 compounds, and linalool (26.34%), α-terpineol (10.84%), trans geraniol (9.83%), α-bisabolol (4.50%), cis-nerol acetate (5.28%), lavandulyl acetate (4.32%) were found as major products.

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Introduction

Plants have been used widely for medicinal purposes for years. In addition, due to their bioactive compounds content, they play a significant role for drug discovery and development process. (Topçu et al., 1999; Demirtas et al., 2013; Sahin Yaglioglu et al., 2013; Aksit et al., 2014; Erenler et al., 2014). Medicinal plants were reported to exhibit considerable biological activities such as antioxidant, antimicrobial, antiproliferative activities (Kına et al., 2021; Korkmaz et al., 2021; Mohammed et al., 2021; Akgül et al., 2022).

The Oleaceae family, which consists of 25 genera and about 600 species, are shrubs, trees, and woody climbers. This family has a wide distribution from temperate to subtropical regions. *Chionanthus, Forsythia, Fraxinus, Jasminum, Ligustrum, Olea, Osmanthus, and Syringa* are the most well-known genera belonging to this family (Varga et al., 2019). These economically important species are grown for food, oil, cosmetic, and ornamental. The most widely known among these genera, the genus *Syringa* consists of more than 40 species distributed over the western and eastern parts of Eurasia. *Syringa vulgaris* L., known as lilac, is the most common of this genus It is used as a folk medicine due to its antimicrobial, antioxidant, anti-inflammatory, antihypertensive, antinociceptive and immunomodulatory properties, as well as being grown as an ornamental species and for the perfume industry in the whole European continent. It has been traditionally used to treat gastrointestinal problems (flatulence) and externally as a massage for the treatment of gout and rheumatism, externally for the treatment of varicose veins and rheumatism, as an antipyretic, for the treatment of haemorrhagic wounds, joint and muscle inflammation and pain, and asthma (Woźniak et al., 2018). *Syringa* genus is characterized phytochemically by a wide variety of compounds such as phenylpropanoids, phenolic compounds, hydroxycinnamoyl derivatives, lignans, sesquiterpenes, secoiridoids or secoiridoid glycosides, iridoids. However, the chemical composition can vary considerably depending on the type and part of the plant (Hanganu et al., 2021).

Phenolic compounds, which are very strong antioxidants, are found in this plant (Erenler et al., 2016). Phenolic phytochemicals protect the body against oxidative damage as well as protecting products against

spoilage (Erenler et al., 2017a). The antioxidant properties of phenolic substances are due to their chemical properties such as hydrogen donors, singlet oxygen suppressors, reducing agents (Erenler et al., 2017b). As an antioxidant source of phenolic compounds, they have many biochemical and pharmacological activities, including antiviral, antibacterial, antilipidemic, anti-inflammatory, antidiabetic, neuroprotective, cardioprotective and hepatoprotective properties (Guzel et al., 2017; Yildiz et al., 2017; Elmastas et al., 2018).

Essential oils obtained from plants are usually a multicomponent volatile matrix consisting of hydrocarbons and their oxygenated derivatives (Karan et al., 2018). These derivatives include aldehydes, acids, quinones, esters, ketones, phenol and phenol ethers, alcohols, lactones, furan derivatives, oxides, amines, and sulphur compounds. The compounds found in essential oils are usually terpenoids which are the derivatives of isoprene, monoterpenes, sesquiterpenes, diterpenes and their oxygenated derivatives (Bayir et al., 2014). Essential oils are also a good source of secondary metabolites. Because essential oil components exhibit antioxidant activity, they can protect foods from oxidation and spoilage and provide potential health benefits (Kaya et al., 2014). At the same time, essential oils have become an important source of fragrance and are used as therapeutic agents; they are applied as agents in foods, cosmetics and pharmaceuticals and are an important ingredient in aromatherapy (Türkmen et al., 2014).

In this study, essential oil was generated by steam distillation and the chemical compounds of essential oil was identified by GC/MS/MS analysis.

Materials and Methods

Essential Oil Isolation

Syringa vulgaris L. flowers were collected from Tokat Gaziosmanpasa University campus in June 2021 and dried at shade. *Syringa vulgaris* L. powder (100 g) was mixed with water (1.4 L) and subjected to steam distillation using Clevenger type apparatus for 4 hours to yield essential oil which was kept at +4°C for analysis (Erenler et al., 2018).

GC/MS/MS Analysis

The chemical compounds of *Syringa vulgaris* L. EO were identified by GC-MS/MS (Agilent Technologies 7000 GC/MS Triple Quad with 7890 GC, 7693 Autosampler and 7697A Headspace Sampler) ((30 m, 0.25 mm inner diameter, 0.25 μm film thickness) equipped with a DB-5 glass capillary column. The carrier gas was helium with 1 mL/min. The solvent was hexane, the injection volume was 1 μL, and the split mode (50:1). The septum purge flow and transfer line temperature were 3 mL/min and 250°C respectively. Quadrupole temperature was 150°C. The column stationary phase was (5%phenyl) methyl poly siloxane. The inlet temperature was 250°C and MS scan range was 35/550 amu.

The essential oil compounds were elucidated by linear retention index calculated with the reference of the retention times of n-alkanes series (C8-C20), and the comparison of mass spectral fragmentation patterns with the authentic compounds in Adams (Adams 2007), and the NIST database (Stein et al., 2002).

Results and Discussion

The essential oil was obtained from *Syringa vulgaris* L. flowers by hydrodistillation using a Clevenger apparatus. The chemical composition of EO of *Syringa vulgaris* L. was determined by the GC/MS/MS analysis and results were presented in Table 1. The 55 components representing 97% of the total detected constituents were identified. The major constituents in the EO were linalool (26.34%), α-terpineol (10.84%), trans-geraniol (9.83 %), cis-nerol acetate (5.28 %), α-bisabolol (4.50 %), lavandulyl acetate (4.32 %), β-caryophyllene oxide (2.97%), camphor (2.47 %) and cis-geraniol (2.21 %). The predominant percentage EO constituents were monoterpene hydrocarbons and oxygenated monoterpenes with 37.27% and 19.82%, respectively. The sesquiterpenes and oxygenated sesquiterpenes make up 0.18% and 16.4% of essential oils. The percent of oxygenated diterpene was found as 4.31%. Linalool, main constituent of EO of *Syringa vulgaris* L. is known to reveal several biological effects such as anticancer, antioxidant, antimicrobial, and anti-inflammatory (Kamatou; Viljoen 2008). The scientific study indicated that brain levels of acetylcholine is reduced of people with Alzheimer's disease. The inhibition of the acetylcholinesterase enzyme results in the increase of the acetylcholine. As a result, increasing the amount of acetylcholine may reduce cognitive decline in people with Alzheimer's disease and related conditions. The terpenes including linalool was reported to inhibit the acetylcholinesterase enzyme (Savelev et al., 2003). The main constituents of essential oil from *Syringa pinnatifolia* Hemsl. var. *Alashanensis* were determines as α-cadinol (19.9%) and τ-muurolol (18.5%) followed by copaene (4.5%), δ-cadinene (4.37%) and α-muurolene (3.29%) and it revealed the considerable activities against hypoxia, and oxidative stress (Yan et al., 2010).

Conclusion

The essential oil compounds of *Syringa vulgaris* L. were determined. Due to the significant phytochemical content of essential oil of *Syringa vulgaris* L. such as linalool, which is known to reveal several biological activities, the corresponding essential oil has a potential to be used in cosmetic, and pharmaceutical industries.

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Table 1. Essential oil compounds of *Syringa vulgaris* L. flowers

No	RT	RI[a]	RI[b]	Constituents	Conc.%
1	11.35	426	428	Heptacosane	0.39
2	12.86	475	477	Nonacosane	0.25
3	13.06	982	985	3-Octanone	0.08
4	14.03	994	992	β-Myrcene	0.40
5	14.54	997	995	Hexyl acetate	0.16
6	14.72	1011	1007	o-Cymene	0.07
7	16.09	1033	1035	Eucalyptol Oxygenated	0.22
8	16.37	1036	1038	Limonene	0.35
9	17.49	1065	1062	trans-Linalool oxide	0.73
10	18.11	1082	1085	Linalool	26.34
11	18.46	1109	1106	p-Mentha-2.8-dienol	0.06
12	18.53	1143	1146	Camphor	2.47
13	18.67	1160	1162	cis-Linalool 3.7-oxide	0.24
14	18.86	1169	1168	Lavandulol	0.10
15	18.94	1177	1179	4-terpineol	0.23
16	19.15	1185	1187	α-Terpineol	10.84
17	20.17	1192	1194	1-Octenyl acetate	0.33
18	21.22	1211	1209	Octyl acetate	0.13
19	21.48	1215	1218	cis-Geraniol	2.21
20	21.52	1219	1220	Lilac alcohol A	0.10
21	21.63	1228	1229	Hexyl 2-methylbutyrate	0.47
22	22.39	1232	1235	trans-Geraniol	9.83
23	23.13	1242	1245	Carvone	0.06
24	23.96	1270	1269	α-Citral	1.15
25	24.28	1285	1286	Bornyl acetate	0.19
26	25.07	1289	1290	Lavandulyl acetate	4.32
27	25.25	1325	1327	8-Hydroxylinalool	0.16
28	25.65	1335	1336	Hexyl tiglate	0.97
29	26.18	1354	1355	α-Terpinyl acetate	0.13
30	26.32	1365	1368	cis-Nerol acetate	5.28
31	27.17	1395	1397	2-Ethylidene-6-methyl-3.5-heptadienal	1.07
32	28.21	1451	1449	cis-α-Bergamotene	0.06
33	28.85	1512	1511	γ-Cadinene	0.12
34	29.21	1514	1516	Geranyl isobutyrate	1.17
35	29.93	1529	1528	1.13-Tetradecadien-3-one	1.08
36	31.59	1564	1566	trans-Nerolidol	1.07
37	32.72	1576	1577	δ-Cadinol	1.06
38	33.07	1590	1591	Viridiflorol	1.06
39	33.89	1599	1601	β-Caryophyllene oxide	2.97
40	34.12	1606	1607	Humulene epoxide 2	0.12
41	37.43	1618	1619	3.7-Cycloundecadien-1-ol. 1.5.5.8-tetramethyl	0.14
42	38.22	1641	1643	Cubenol Oxygenated	1.13
43	39.01	1671	1672	Isolongifolol. methyl ether	1.23
44	39.17	1673	1674	Allohimachalol	1.05
45	39.43	1683	1685	α-Santalol	1.13
46	40.91	1701	1703	α-Bisabolol	4.50
47	41.41	1752	1755	1.5.9-Trimethyl-1-vinyl-4.8-decadienyl formate	1.05
48	43.75	1823	1824	Dehydrosesquicineole	1.08
49	43.93	1892	1895	Corymbolone	1.10
50	47.00	2032	2035	Thunbergol	1.10
51	47.49	2097	2094	Methoprene	1.08
52	47.64	2100	2103	Heneicosane	1.31
53	51.69	2128	2129	Phytol	1.05
54	54.05	2201	2204	trans-Geranylgeraniol	1.11
55	59.35	2392	2395	Caryophylladienol II	1.05
Monoterpenes (Sr. No. 4, 6, 7, 8, 10, 22, 23)					37.27
Oxygenated monoterpenes (Sr. No. 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 24, 27, 31)					19.82
Sesquiterpenes (Sr. No. 32, 33)					0.18
Oxygenated sesquiterpenes (Sr. No. 36, 37, 38, 39, 40, 41, 42, 44, 45, 46, 48, 49)					16.41
Oxygenated diterpenes (Sr. No. 50, 53, 54, 55)					4.31
Others (Sr. No. 1, 2, 3, 5, 21, 25, 26, 28, 29, 30, 34, 35, 43, 47, 49, 51, 52)					19.16
Total					97.15

RT: retention time, [a]RI: retention index calculated from n-alkane (C8 – C20) on DB-5 column, [b]RI: retention index of literature (Adams 2007).

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