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Original Article

Study on Chemical Composition of Essential Oil in *Cotinus coggygria* Scop (Smoke Tree) from Iran.

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Abstract

Plants of the family Anacardiaceae have a long history of use by various peoples for medicinal and other purposes. *Cotinus coggygria*, also known as the "smoke tree", is one of the two species constituting a small genus of the family Anacardiaceae, viz., *C. coggygria* Scop. (syn.: *Rhus cotinus* L.) The Iranian smoke tree, plant material air-dried *C. coggygria* were collected in early stage of flowering on 12 July 2017 and seconed sample were extracted on late stage of flowering on 10 october 2017 in Research Institute of Forests and Ranglands. Both samples essential oil were extracted by water-distilled (Clevenger apparatus type) for 3 hrs. on early stage of flowering (75 gram) on 12 July 2017 and seconed sample were extracted on late stage of flowering (400 gram) on 10 october 2017 were 0.66% and 0.032% (V/W), respectively, and analyzed by GC and GC/MS. Main components from early stage of flowering were n-dodecanol (7.6%), spathulenol (7.5%), (2Z, 6E)-farnesyl acetate (7.1%), germacrene B (7%) and isolongifolol (4.7%), and for late stage of flowering were (Z)- β-ocimene (45.8%), (E)- β-ocimene (6.9%), α- pinene (7.6%) and trans-sabienene hydrate (6.9%), identified . Commercial-grade ocimene is used as a starting material for the manufacture of a number of perfume chemicals, and it is also used occasionally as a perfume material since it creates very pleasant effects with bay oil in modem spicy-herbaceous fragrances.

Keywords: Anacardiaceae, *Cotinus coggygria,* Main components, Chemical Composition

Introduction

Anacardiaceae Lindl. is an economically important family of 82 genera and over 700 species. This family is distributed in the tropics of Africa, Asia and America with a smaller number of species occurring in subtropical and temperate areas [1]. In general, the plant essential oils and extracts of many plant species are considered as non-phytotoxic compounds and have been examined for a number of biological activities so far, and their antimicrobial, anti-inflammatory, antioxidant, antimutagenic, and cancer preventive effect have been partially described [2-4].

Plants of the family Anacardiaceae have a long history of use by various peoples for medicinal and other purposes. Different parts of this plant have been subjected to pharmacological evaluation for their potential antiseptic, anti-inflammatory, antimicrobial, hepatoprotective [5], antihemorrhagic agent in wound-healing [6], as well as for countering diarrhea, paradontosis, and gastric and duodenal ulcers [7].

This is the first report about the composition of the essential oil from flowering aerial parts of *Cotinus coggygria* Scoop. (Anacardiaceae) from Italy. The major compounds identified by GC-MS were limonene (47.1%), *(Z)*-β-ocimene (15.2%), α-pinene (8.5%) and *(E)*-β-ocimene (5.3%). The oil showed antimicrobial activity against three Gram (+) bacteria: *Bacillus cereus, Staphylococcus aureus,* and *S. epidermidis*, and three *Candida* strains: *C. albicans, C. glabrata* and *C. tropicalis,*

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while it was inactive against three Gram (-) bacteria: *Pseudomonas aeruginosa, Escherichia coli* and *Enterobacter cloacae* [8]. In the oils from Turkey the main constituents were limonene 48.5%, (Z)-β-ocimene 27.9% and (E)-β-ocimene 9.7% [6].

In the oils from Hungary the main constituents were limonene 30.0–40.0%, α-pinene 24.4–34.3%, β-pinene 7.6–20.2%, Δ3-carene 4.6–11.0%, and α-terpinolene 3.3–10.6% [9].

Thirty-eight components from group of monoterpenes and sesquiterpenes were characterized in the essential oils from the flowers of *C. coggygria* from the south Serbia, forty-three components in oil from the leaves and twenty-five components in oil from the stems. The main constituents in the essential oils of flowers, leaves and stems were the monoterpenes limonene (39.5%, 6.5% and 3.39%) and α-pinene (16.0%, 15.1% and 21.9%), respectively [10].

Analyses of two essential oils, both obtained from the leaves with young twigs of wild-growing *C. coggygria* from two localities in Serbia (Deliblatska peščara and Zemun), showed very similar chemical composition with monoterpenic hydrocarbons dominating (87.4% and 93.1%, respectively) The major components, i.e. limonene (47.0% and 39.2%), (Z)-β-ocimene (16.4% and 26.3%), α-pinene (8.2% and 8.4%), (E)-β-ocimene (4.6% and 9.0%) and terpinolene (6.8% and 5.3%) were the same in both oils [11]. In the oils from Bulgaria the main components were α-pinene 44.0%, limonene 20.0%, β-pinene 11.4% [12].

In the oils from Greece the main components were different in different samples: in the first oil, the main constituents were limonene 67.4%, α-pinene 14.7%, and terpinolene 8.6%; in the second, myrcene 32.0%, sabinene 18.0%, and α-pinene 15.9%; in the third oil, main components were sabinene 24.2%, myrcene 14.0%, limonene 10.9% and terpin-4-ol 10.9% [13].

Cotinus coggygria, also known as the "smoke tree", is one of the two species constituting a small genus of the family Anacardiaceae, viz., *C. coggygria* Scop. (syn.: *Rhus cotinus* L.) and *Cotinus obovatus* Raf., the Iranian smoke tree. It has a wide distribution from southern Europe, the Mediterranean, Moldova and the Caucasus to central China and the Himalayas [11].

This plant has been used in folk medicine throughout the world and the medicinal properties have been investigated. *C. coggygria* is an important source of essential oils and extract with a wide range of health-promoting properties. A number of publications have reported the biological activities of extracts and essential oils from *C. coggygria* Scop. To the best of our knowledge, no study so far has been performed to summarize all the reported data on *C. coggygria* and respective biological properties. For this reason, the present study mainly focused on essential oil from plant *C. coggygria*.

This plant is usually either considered as large shrubs or small trees. It has glaucous, simple, ovate or obovate leaves, 3–8 cm long. The flowers are pentamerous, pale yellow or yellow–green, hermaphrodite or some of them abortive, with long peduncles, in terminal loose inflorescences [14,15].

Natural products produced as secondary metabolites by higher plants have proven to be an abundant source of biologically active compounds that can be the basis for the development of new chemicals for pharmaceuticals. Plants contain a diverse group of highly valuable and available resource of secondary metabolites, such as tannins, terpenoids, alkaloids, and flavonoids, which have been found to have important pharmacological properties [16, 17, 18].

The extract of *C. coggygria* is also used as a cholagogue febrifuge and for eye ailments (Li, 2009).

The dried leaf and twig of *C. coggygria* is used in Chinese traditional medicine to eliminate "dampness" and "heat" and as an antipyretic [19].

Also, *C. coggygria* syrup has the effect of protecting the liver from chemical damage, reducing tension of the choledochal sphincter, increasing bile flow and raising the body immunity [20].

Method and Materials

Plant Extraction

The plant material air-dried *C. coggygria* were collected in early stage of flowering on 12 July 2017 and seconed sample were extracted on late stage of flowering on 10 october 2017 from Research Institute of Forests and Ranglands. Both samples essential oil were extracted by water-distilled (Clevenger apparatus type) for 3 hrs. on early stage of flowering (75 gram) on 12 July 2017 and seconed sample were extracted on late stage of flowering (400 gram) on 10 october 2017 were 0.66% and 0.032% (V/W), respectively, and analyzed by GC and GC/MS. Samples were dried with anhydrous sodium sulfate and kept in vials at 4 °C until essential oil analysis.

GC: The GC analysis were performed using a Shimadzu-9A gas chromatograph equipped with a flame ionization detector, and quantitation was carried out on Euro Chrom 2000 from Knauer by the area normalization method neglecting response factors. The analysis was carried out using a DB-1 fused-silica column (60 m x 0.25 mm, film thickness 0.25 µm, J & W Scientific Inc., Rancho Cordova, CA, USA). The operating conditions were as follows: injector and detector temperature, 250 °C and 265 °C, respectively; carrier gas, helium. Oven temperature program was 40-250 °C at the rate of 4 °C/min.

GC/MS*:* The GC/MS unit consisted of a Varian Model 3400 gas chromatograph coupled to a Saturn II ion trap detector was used. The column was same as GC, and the conditions were the same as above. Mass spectrometer conditions were: ionization potential 70 eV; electron multiplier energy 2000 V.

The identity of the oil components was established from their GC retention indices, relative to C7- C25 n-alkanes, by comparison of their MS spectra with those reported in the literature [21-23], and by computer matching with the Wiley 5 mass spectra library, whenever possible, by co-injection with standards available in the laboratories.

Result

Main components from early stage of flowering were n-dodecanol (7.6%), spathulenol (7.5%), (2Z, 6E)-farnesyl acetate (7.1%), germacrene B (7 %) and isolongifolol (4.7%), and for late stage of flowering were (Z)- β-ocimene (45.8%), (E)- β-ocimene (6.9%), α- pinene (7.6%) and trans-sabienene hydrate (6.9%), identified. (Table 1).

Conclusion

In this study our results were extracted from two stage on early stage of flowering (75 gram) on 12 July 2017 and seconed sample were extracted on late stage of flowering (400 gram) on 10 october 2017 were 0.66% and 0.032% (V/W), respectively, and analyzed by GC and GC/MS. Main components from early stage of flowering were n-dodecanol (7.6%), spathulenol (7.5%), (2Z, 6E)-farnesyl acetate (7.1%), germacrene B (7%) and isolongifolol (4.7%), and for late stage of flowering were (Z)- β-ocimene (45.8%), (E)- β-ocimene (6.9%), α- pinene (7.6%) and trans-sabienene hydrate (6.9%), identified .

compare with others analyses of two essential oils, both obtained from the leaves with young twigs of wild-growing *C. coggygria* from two localities in Serbia (Deliblatska peščara and Zemun), showed very similar chemical composition with monoterpenic hydrocarbons dominating (87.4% and 93.1%, respectively) The major components, i.e. limonene (47.0% and 39.2%), (Z)-β-ocimene (16.4% and 26.3%), α-pinene (8.2% and 8.4%), (E)-β-ocimene (4.6% and 9.0%) and terpinolene (6.8% and 5.3%) were the same in both oils [11].

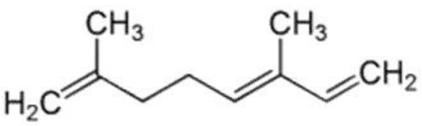
In the study of Novakovıć *et al*.2007, essential oils obtained via hydrodistillation of the young branches and leaves of *Cotinus coggygria* were analyzed via GC-MS, hydrocarbons, the dominant component being limonene. In a study of the composition of essential oil obtained from the leaves of *Cotinus coggygria* Scop., Demirci *et al*.2003, also reported that the dominant component was limonene, but found that the oil comprised 42 components. Savikin *et al*.2009, determined the total phenol content in extracts from the flowers and leaves of the plant to be 76.5±4.2 and 515.5±8.3 mg GAEg-1, and the tannin content to be 13.7%±0.9% and 18.5%±1.1%, respectively. It is important to bear in the test may be correlated with a high activity of its chemical components.

As you can see in the table, in the Late stage of flowering, the (Z)- β – ocimene (45.8%) and (E)-β – ocimene (6.9%) has increased from zero to more than 52%. cis-Ocimene is found in allspice. Ocimene refers to several isomeric hydrocarbons. The ocimenes are monoterpenes found within a variety of plants and fruits. α-Ocimene and the two β -ocimenes differ in the position of the isolated double bond: it is terminal in the alpha isomer. α -Ocimene is 3,7-dimethyl-1,3,7-octatriene. β -Ocimene is 3,7-dimethyl-1,3,6-octatriene. β -Ocimene exists in two stereoisomeric forms, cis and trans, with respect to the central double bond. The ocimenes are often found naturally as mixtures of the various forms. The mixture (as well as the pure compounds) is an oil with a pleasant odor. It is used in perfumery. The mixture, as well as the pure compounds, are oils with a pleasant odor. They are used in perfumery for their sweet herbal scent, and are believed to act as plant defense and have anti-fungal properties (SCLabs).

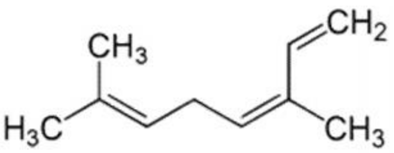
Table 1 Chemical Composition of Essential Oil of *Cotinus coggygria* Scop (smoke tree) from Iran.

Compounds	R.I.	Early flowering	Late flowering
Tricyclene	922	0.6	-
α- pinene	945	-	7.6
β- pinene	985	-	2.2
δ-2- careen	994	-	1.8
p-cymene	1017	-	0.3
Limonene	1033	1.8	-
(Z)- β –ocimene	1051	-	45.8
(E)- β – ocimene	1057	-	6.9
Cis-sabinene hydrate	1064	0.5	0.3
Terpinolene	1084	0.6	-
2-nonanone	1087	0.7	0.5
Trans- sabinene hydrate	1093	1.0	6.1
3-octanol acetate	1123	-	0.2
1-terpineol	1130	-	0.8
p-menth-3-en-8-ol	1145	-	0.5
Borneol	1165	1.0	0.2
Linalool oxide	1171	1.4	0.9
Terpinen-4-ol	1175	3.9	0.8
Neo-verbanol	1185	0.3	0.3
Verbanol	1196	0.6	0.1
Iso-dihydro carveol	1212	1.5	0.2
Tetrahydro-linalool acetate	1229	2.3	0.3
Cis- carvone oxide	1262	0.9	0.4
Dihydro-linalool acetate	1270	0.7	0.7
Cis-verbenyl acetate	1280	-	0.9
γ- terpinen-7-al	1289	1.3	1.3
Methyl decanoate	1322	1.9	0.1
α- longipinene	1351	0.7	-
Carvacrol acetate	1369	0.5	-
Geranyl acetate	1380	1.4	0.3
Ethyl decanoate	1393	0.9	0.5
β- longipinene	1395	-	0.4
(E)- caryophyllene	1416	-	0.2
Methyl undecanoate	1429	0.9	5.0
Epi- β- santalene	1446	0.5	1.7
α- humulene	1453	-	0.7
Dehydro-aromadendrane	1460	2.5	0.2
n-dodecanol	1468	7.6	0.6
γ- gurjunene	1476	0.8	1.1
γ- himachalene	1480	-	0.2
Germacrene D	1483	-	0.2
Cis-eudesma-6,11-diene	1487	1.2	0.6
10-undecenol acetate	1497	0.4	-
α- muurolene	1501	-	0.6
γ- cadinene	1512	0.3	1.0
δ- cadinene	1523	1.1	0.2
α- cadinene	1539	1.2	-
Germacrene B	1554	7.0	-
(E)- nerolidol	1561	1.6	-
n-tridecanol	1568	0.7	0.3
Spathulenol	1575	7.5	2.1
Caryophyllene oxide	1585	1.3	0.5
Cedrol	1597	0.9	0.5
Geranyl isovalerate	1604	0.4	-

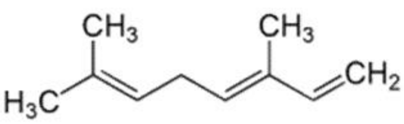
β- himachalene oxide	1616	0.7	-
Hexyl phenylacetate	1625	1.3	0.2
γ- eudesmol	1628	-	0.3
Phenyl ethyl hexanoate	1641	-	0.3
Cubenol	1645	1.2	0.2
Geranyl valerate	1655	1.1	0.3
Dihydro- eudesmol	1661	2.2	-
Occidenol	1677	0.8	-
Occidentalol acetate	1681	1.1	-
14-hydroxy-4,5-dihydro-caryophyllene	1706	0.7	-
(2E, 6Z)- farnesol	1717	1.1	-
(2Z, 6E)- farnesol	1720	0.6	-
Iso-longifolol	1728	4.7	-
Isobicyclogermacrenal	1735	1.2	-
(2E, 6E)- farnesol	1739	1.2	-
α- bisabolol oxide A	1746	1.2	-
(E)- nuciferol	1754	0.7	-
γ- eudesmol acetate	1785	0.6	-
β- chenopodiol	1810	2.8	-
(2Z, 6E)- farnesyl acetate	1821	7.1	0.4
(5Z, 9E)- farnesyl acetone	1885	1.4	0.5
(5E, 9E)- farnesyl acetone	1913	0.3	-
Cyclohexadecanolide	1935	2.4	-
Isopropyl hexadecanoate	2027	-	0.2
Sclareolide	2064	-	0.3
n- octadecanol	2075	0.7	0.4
n-heneicosane	2103	2.3	-
Laurenan-2-one	2116	0.5	-
-	-	98.4 %	99.2 %
Oil %		0.66	0.0325



α-Ocimene



cis-β-Ocimene



trans-β-Ocimene

Like the related acyclic terpene myrcene, ocimenes are unstable in air [24]. Like other terpenes, the ocimenes are nearly insoluble in water, but soluble in common organic solvents. The name is derived from the plant genus name *Ocimum* [25]. from the Ancient Greek word for basil. Its sweetness is almost floral, evoking an immediate similarity to neroli oil in the odor of pure ocimene [26]. It also has vegetable nuances, and when tasted it has a green, tropical, woody flavor with floral and vegetable nuances [27]. Ocimene occurs in ho leaf oil, hop oil, kumquat, mango, mint, neroli, bigarde oil, parsley, pepper, petitgrain, bergamot oil, lavender and more. Pure ocimene can be used in numerous artificial essential oils, bergamot, lavandin, neroli, orange, basil, etc., but it is also in itself an interesting material for a new and powerful top-note effect in citrus colognes, lavender and fougere. It also has applications in mango and spicy-herbaceous fragrances, as well as limited use in household product fragrances. There is a very considerable difference in price between ordinary grade ocimene and pure ocimene, but the terpene is often used so sparingly that it compensates for its relatively high cost. Commercial-grade ocimene is used as a starting material for the manufacture of a number of perfume chemicals, and it is also used occasionally as a perfume material since it creates very pleasant effects with bay oil in modem spicy-herbaceous fragrances [25].

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