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Essential oil content and composition of *Cotinus coggygria* Scop. from Hatay, Turkey

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Abstract

Cotinus coggygria Scop. (Anacardiaceae) is generally cultivated for industrial purposes in many countries. Present study was aimed to identify and essential oil contents and composition of smoke tree (*C. coggygria*) plants collected from Hatay province. GC-MS (Gas Chromatography Mass Spectrometry) was used to analyze the essential oil contents and determine their composition in the leaves. In the present study essential oil content was found as 1.66%. Totally eighteen different components were identified from the leaves, representing 98.67% of the total components detected. Sesquiterpene hydrocarbons and monoterpenes were composed most of the essential oil. The main constituents were identified as caryophyllene oxide (9.87%), α-myrcene (8.80%), β-caryophyllene (12.71%), germacrene-d (14.65%) and geranyl acetate (39.87%). The essential oil from Hatay resulted in higher essential oil content with higher geranyl acetate that could be useful in different industries.

Key words: Smoke tree, Anacardiaceae, gas chromatography

Introduction

The genus *Cotinus* from Anacardiaceae family is a small genus with only two species *C. coggygria* Scob (European smoketree) and *C. obovatus* Raf. (American smoketree). *C. coggygria* Scob. (syn. *Rhus cotinus*) is a perennial, large shrub or small tree that native to a large area from southern Europe, southern Russia, Crimea, Caucasia, Turkey to Central China (Davis, 1984). This plant is widely distributed from almost all parts of Turkey from 1 to 1300 m mainly around Southern part throughout the Mediterranean. Turkish vernacular names for the species are 'duman çalısı', 'Pamuklu sumak' and 'tetra' (Guzel et al. 2015; Kultur, 2007) which indicate the panicles are 'smoky' pink and can cover a plant. There approximately 30 cultivars of *C. coggygria* exists and 'Daydream', 'Grace', 'Nordine', 'Norcutt's variety', 'Royal purple' and 'Velvet Cloak' are the most known (Anonymous, 2020). The European smoke tree also known as 'smoke bush' grows up to 5-7 m tall. The leaves are petiolate, obovate to broadly eliptic to orbicular, sparsely pilose and glabrescent. Flower sepals ca. 1.5 mm, petals are whitish green, flowers are hermaphrodite or some of them abortive with peduncles (Davis, 1984). Natural habitat of the species is maquis, dominated by evergreen shrubs, covers much of the Mediterranean territory of Turkey. The main plants covering the areas below 1000 or 1200 m are: *Arbutus andrachne*, *Calycotome villosa*, *Carpinus betulus*, *Celtisaustralis*, *Ceratonia siliqua* and *Cistus criticus*.

The plant is used in folk medicine for different purposes. In different countries, *C. coggygria* wood or leaf preparations by decoction and infusion are used for its antiseptic, wound healing, anti-inflammatory, antimicrobial properties (Tsankova et al., 1993; Demirci et al., 2003; Guzel et al., 2015).

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In Turkey mostly decoction from leaves have been used for treatment of stomach pain, eczema, diabetes, anthrax, kidney stones, asthma and urinary diseases (Kultur et al., 2007). Bulgaria uses naturally growing trees to produce essential oils, that has been used in perfumery, from its leaves and young branches (Tsankova et al., 1993). The plant is also used as ornamental plant and the roots are used for dying (Baytop, 1999; Arampatzis, 2001; Matic et al., 2015). The plant parts have been studied to investigate different biological properties. Anticancer (Marčetić et al., 2012; Wang et al., 2016), immune stimulants (Shen et al., 1991; Bilen et al., 2019), antipyretic (Huang, 1999), antimicrobial (Novaković et al., 2007; Tunç et al., 2013; Fraternale and Ricci., 2014), anti-inflammatory (Marcetić et al., 2013) and wound healing (Aksoy et al., 2016) are some of the examples of researches that conducted on *C. coggygria*. The leaves and young shoots of the species contain tannins, glycosides, and anthocyanins, also these plant parts reported to safe to use as food and food additives (Anonymous, 2014).

There are several previous studies which investigated essential oil composition of *C. coggygria* from Turkey, Bulgaria, Hungary, Greece, Serbia and Italy (Hethelyi et al., 1986; Tsankova et al., 1993; Demirci et al., 2003; Tzakou et al., 2005; Novaković et al., 2007; Fraternale and Ricci, 2014). Previous studies showed that essential oil composition of *C. coggygria* mostly dominated by monoterpenic hydrocarbons. Bulgarian *C. coggygria* plants essential oils have a characteristic terpene-like aroma and have been used in perfumery industry (Novaković et al., 2007). The previous study from flora of Turkey revealed that the plant contained high percentage of ocimenes is regarded as important in perfume industry (Demirci et al., 2003). The flora of Hatay where the *C. coggygria* plant materials of present study were collected, is located in the Mediterranean phyto geographic region and three main vegetation types could be found together in the area (Turkmen, 2018). The aim of this study was to introduce the essential oil composition of *C. coggygria* from flora of Hatay and to give opinion for future assessments. In this work, essential oil content and composition of wild-growing *C. coggygria* were investigated.

Materials and Methods

Plant Material

The plant materials (leaves) were collected in September, 2019. The plants were deposited in the Herbarium of the Medicinal and Aromatic Plants Lab of University of Hatay Mustafa Kemal. After collecting, leaves were air dried at room temperature.

Isolation and Analyze of the Essential Oil

Dry leaves were hydro distilled for 3 hours with using Clevenger-type apparatus. Essential oil ratio was calculated as the mean value from dry plant material weight and expressed in g/100 g dry weight percentage. Essential oils were kept in amber vials at +4 °C until analysis. The essential oil analysed with the method from Bahadirli and Ayanoglu (2019) was used. Essential oil components were then analysed with GC-MS (Gas Chromatography Mass Spectrometry) device Thermo Scientific ISQ Single Quadrupole. 5 µl of essential oil was diluted in 2 ml cyclohexane. For separation, TG-Wax MS (5% Phenyl Polysilphenylene-siloxane, 0.25 mm inner diameter * 60 m length, 0.25 µm film thickness) column was used. The ionization energy was calibrated as 70 eV, and the mass interval was m/z 1.2- 1200 amu. The scan mode was used as the screening more in data collection. MS transfer line temperature was 250°C, MS ionization temperature was 220°C, and whereas colon temperature was 50°C at the beginning, then it was increased up to 220°C with 3°C/min rate. The structure of each component was defined using mass spectrums (Wiley 9) with Xcalibur software. Retention indices were determined using retention times of *n-alkanes*(C8-C40) that were injected after the *C. coggygria* essential oil under the same chromatographic conditions.

Results and Discussions

In the present study essential oil content and composition of *C. coggygria* were identified and results were given in Table 1. Essential oil content was found as 1.66%. Results of present study are generally in accordance with the findings of previously published literatures from different countries. For example, essential oil content of different part of wild plant samples from Greece ranged from 1.24-3.49% (Tzakou et al., 2005), while fresh aerial plant samples essential oil content from Bulgaria found as 0.23% (Novakovic et al., 2007). Demirci et al. (2003), found essential oil yield from Eskisehir, Turkey as 0.87%. Ulukanli et al. (2004) found essential oil content as 0.2%.

Component analysis for the essential oil resulted with 18 different components, representing 98.67% of the total components detected. The major constituents were identified as caryophyllene oxide (9.87%), α-myrcene (8.80%), β-caryophyllene (12.71%), germacrene-d (14.65%) and geranyl acetate (39.87%).

Table 1. Essential oil composition of *C.coggygria* L. (%)

Essential oil content		1.66%
RRI*	Compound Name	%
1098	Camphene	0.43
1148	Sabinene	0.41
1159	*α*-Myrcene	8.80
1206	Limonene	0.70
1229	*α*-Ocimene	0.33
1239	*γ*-Terpinene	0.40
1243	*β*-Ocimene	0.66
13021	Cymene	0.39
1423	1-Octen-3-yl acetate	0.39
1533	Linalool	0.92
1616	*β*-Elemene	0.58
1666	*β*-Caryophyllene	12.71
1713	*β*-Humulene	6,60
1742	Germacrene-D	14.65
1759	Geranyl acetate	39.87
1791	Nerol	1.15
2024	*β*-Ionone	0.16
2084	Caryophyllene oxide	9.87
	Total	98.67

*RRI= Relative retetntion indices were calculated against *n*-alkanes

According to previous results, there is a great variation in the essential oil composition of *C. coggygria.* However, unlike our results major constituent was limonene, pinene, myrcene and ocimene. In the present study limonene and ocimene contents were found to be less than 1%. The main constituents of essential oils from Hungary 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% (Hethelyi et al., 1986). Major components of commercial essential oil sample from Bulgaria found as *α*-pinene 44.0%, limonene 20.0%, *β*-pinene 11.4% (Tsankova et al., 1993). Leaf essential oil from Turkey has resulted in limonene 48.5%, (*Z*)-*β*-ocimene 27.9% and (*E*)-*β*-ocimene 9.7% (Demirci et al., 2003).

Inflorescences, infructescence and leaves were analysed from different locations in Greece. In the study major components of leaf were *α*-pinene (5.5-15.9%), sabinene (tr-24.2%), myrcene (1.5-32.0%) and limonene (tr-67.4%). Main components of inflorescences parts were *α*-pinene (32.4%), limonene (67.4%) and terpinolene (8.6%). Major essential oil components at infructescence parts were sabinene (15.5-41.4%), myrcene (9.3-29.5%) and terpinen-4-ol (7.1-8.8%) (Tzakou et al., 2005). In other study, leaf essential oil from natural flora of Serbia showed that major components were limonene (39.2-47.0%), (*Z*)-*β*-ocimene (16.4-26.3%), *α*-pinene (8.2-8.4%), *(E)*-*β*-ocimene (4.6-9.0%) and terpinolene (5.3-6.8%) (Novaković et al., 2007). In another study from south Serbia different plant parts were estimated. The main constituents in 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 (Milosevic et al., 2008). Essential oil of flowering aerial parts of the plant from Italy contained limonene (47.1%), (Z)-*β*-ocimene (15.2%), *α*-pinene (8.5%) and (E)-*β*-ocimene (5.3%) (Fraternale and Ricci, 2014). Ulukanli et al. (2014) found main components of leaf essential oil as *α,*-pinene (43.1%), limonene (21.3%), *β*-myrcene (8.5%), *α*-terpinolene (5.0%), *β*-pinene (3.4%), *α*-terpinene (3.3%) and *β*-caryophyllene (2.4%). Leaf essential oil components from India identified as *α*-phellandrene (7.83%), *α*-myrcene (5.36%), (+)-2-bornanone (14.52%), caryophyllene (7.65%), (+)-epi-bicyclosesquiphellandrene (5.59%), *δ*-elemene (9.56%), globulol (7.95%) (Shagun et al., 2016).

The major components geranyl acetate and germacrene-d have been used in perfumes, cosmetic industry and also as a flavouring ingredient (Ng et al., 2016; Sikka and Bartolome). The essential oil from Hatay flora could also use in cosmetic industry.

Conclusions

In the present study *Cotinus coggygria* essential oil from flora of Hatay were identified. The essential oil yield was found higher than many other studies, where the essential oil constituents was also significantly varied. Future studies about ontogenetic variability of essential oil composition and biological properties are important for the clarifications of the use of *C. coggygria* leaves in cosmetic industry.

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