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Evaluation of Chemical Composition of *Vitex agnus-castus* (Verbenaceae) Fruits Essential Oils Grown in Aydın/Turkey

Aydın/Türkiye'de Yetişen *Vitex agnus-castus* (Verbenaceae) Meyve Uçucu Yağlarının Kimyasal Bileşiminin Değerlendirilmesi

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Abstract

In this study was aimed to investigate the chemical composition determination of essential oils of *Vitex agnus-castus* fruits growing under the ecological conditions of Aydın's. The essential oil was carried out with Clevenger apparatus and composition was determined by Gas Chromatography-Mass Spectrometry (GC-MS). As a result, a total of 157 components were detected in *V. agnus-castus* fruits. Among them, 1,8 cineole (8.24%), propenamide (6.07%), caryophyllene (5.56%), bicyclogermacrene (5.51%), sabinene (5.37%), maleimide (5.28%), *trans-β*-farnesene (4.45%), and α-pinene (3.98%) were found as the major components.

Key Words: GC-MS, essential oils, *Vitex agnus-castus*, Turkey.

Öz

Bu çalışmada Aydın ekolojik koşulları altında yetiştirilen *Vitex agnus-castus* meyvelerinin uçucu yağlarının kimyasal bileşim tayini Ekstraksiyon Clevenger cihazı ile gerçekleştirildi ve uçucu yağ bileşimi, Gaz Kromatografisi-Kütle Spektrometresi (GC-MS) ile belirlendi. Sonuç olarak, *Vitex agnus-castus* meyvelerinde toplam 157 bileşen tespit edildi. Bunların arasında 1,8 sineol (% 8.24), propenamid (% 6.07), karyofillen (5.56%), bisiklogermakren (% 5.51), sabinen (% 5.37), maleimid (% 5.28), *trans-β*-farnesen (% 4.45) ve α-pinen (%3.98) ana bileşenler olarak bulundu.

Anahtar Kelimeler: GC-MS, uçucu yağ, *Vitex agnus-castus*, Türkiye.

1. Introduction

Recently, in order to prevent the growth of food-borne pathogens or to delay the onset of food spoilage there has been a considerable interest in essential oils, medicinal and edible plant extracts, herbs, and spices as for the development of alternative food additives (Çetin et al. 2011). Primers and secondary metabolites produced by plants include a wide variety of functions. Secondary metabolites were later exploited by humans for their beneficial role. At the same time, volatile oils and their components are also being developed for potential multipurpose functional use (Sawamura 2000; Ormancy et al. 2001; Gianni et al. 2005; Chishti et al. 2013). *V. agnus-castus* L. is a medicinal plant belonging to the *Vitex* genus of *Verbenaceae* family (Rice-Evans et al. 1997) which distributed in West Asia and West Africa although its origin is Mediterranean countries (Brickell and Zuk 1996; Blamey and Grey-Wilson 1998). The *Vitex* genus is represented by two species (*V. agnus-castus* and *V. pseudo-negundo* (Hausskn. Ex Bornm.) Hand.-Mazz) in the flora of Turkey (Eryiğit et al. 2015). *V. agnus-castus* is also known as Chastebery or Monk's pepper which widely used for the treatment of several health problems such as acne, insufficient lactation, gynecological disorder, certain menopausal conditions and spasmodic dysmenorrhea in traditional folk medicine. On the other hand, clinical research has proven the efficacy of fruits extract in pre menstrual syndrome (Halaška et al. 1999; Schellenberg 2001; Lucks et al. 2002; Wuttke et al. 2003; Maltaş et al. 2010). In a study, vitexine and vitexinine known as glycoside were found in the leaves of *V. agnus-castus* plant. Moreover, a composition of 0.47% essential oil, a bitter substance castin, glycoside agnoside and some hormone-like substances were also found in the same study (Garnier and Debraux 1961). In another study, researchers stated that the hormone-like substance has a progesterone-like effect on the female mices (Belic et al. 1958). Furthermore, a different study showed that the pharmacological activity of *V. agnus-castus* extract was found similar to Corpus luteum preparations (Bhattacharya et al. 1980). In addition, it is also known that fruit and leaf powder of the *V. agnus-castus* plant protects wooly fabrics against moths (Baytop 1984; Tümen and Sekendiz 1989), besides that luteoline is used in natural painting and colors such as orange-yellow, olive green and light yellow with diverse mordanting methods (Fakir et al. 2014). The aim of the present study was to determine the essential oil contents of fruits of *V. agnus-castus* plants grown under West Anatolian ecological conditions.

2. Materials and Methods

2.1 Plant Materials

The fruit samples of *V. agnus-castus* were collected during September 2015 from Aydın/Koçarlı roadside (approximately 290 m altitude). The collected samples were placed in fabric bags and kept in a room without sunlight.

2.2 Isolation of Essential Oils

Approximately, 150 g fruit samples were used for the essential oil extraction process. Extraction was performed using Clevenger apparatus with water distillation.

2.3 GC-MS Analysis

The qualitative and quantitative of essential oil analysis were conducted at Eskisehir Anadolu University Medicinal Plants, Drugs and Scientific Research Center (AUBİBAM) by Hewlett Packard 5973 Mass Selective Detector System and GC-MS 6890 instrument equipped with an Agilent HP-Innowax colon (60m X 0.25 mm film, 0.25 µm thickness). Helium was used as a carrier gas. Conditions were as follows; from 50°C to 240°C by an increase of 4°C / minutes. At 240°C, 40 minutes of waiting time were implemented. Injection port and detector temperatures were 250°C and 280°C respectively. Characterization of essential oil components was based on the library (Wiley and NIST) comparison with the mass spectra of the injected essential oil samples.

3. Results and Discussion

3.1 Chemical Composition of the Essential Oils

Essential oils extracted from different parts of woody and grassy plants are almost a complex mixture of hydrocarbons, alcohols, esters, aldehydes, carboxylic compounds and phenylpropanoids. Most hydrocarbons are monoterpene compounds, but sesquiterpenes can also be found in plants. Essential oils have well recognized antimicrobial properties, due to their phenolic components (Burt 2004; Holley and Patel 2005; Cassiano 2007; Pirigharnaei et al. 2012). In our study, totally 157 components were detected as *V. agnus-castus* fruit essential oil composition. 81.42% of the total essential oils in 42 components (components which are ≥0.4% in total ratio) were given in Table 1. The essential oils obtained from the fruit of the *V. agnus-castus* plant were detected to contain 1,8 cineole (8.24%), propenamide (6.07%), caryophyllene (5.56%), bicyclogermacrene (5.51%), sabinene (5.37%), *N*-(4-fluorophenyl)-maleimide (5.28%), *trans*-*β*-farnesene (4.45%), *α*-pinene (3.98%) at most (Table 1). There were many previous studies relating to the chemical composition of the essential oils obtained from leafs and fruits of the *V. agnus-castus* plant. Eryiğit et al. (2015) detected *trans*-caryophyllene (19.17%), sabinene (18.05%) and 1,8-cineole (16.13%) at most in the essential oils of fruits of *V. agnus-castus* plant collected from Izmir district of Turkey. Fakir et al. (2014) collected *V. agnus-castus* samples distributed in Isparta region of Turkey in both bloom and fruit maturity periods and examined their essential oils contents. Main components of the essential oils obtained in bloom period were defined as *α*-pinene (26.99%), 1,8-cineole (14.20%), trans-caryophyllene (9.13%), sabinene (8.29%), germaseren-B (8.20%), limonene (6.53%), 1,6,10-dodecatriene (6.37%), while main components of the essential oils obtained in fruit maturity period were detected as 1,8-cineole (28.34%), *α*-pinene (26.96%), sabinene (16.36%) and limonene (9.08%). According to the study of Moudachirou et al. (1998) examining essential oil contents of the leaves of *V. agnus-castus* samples collected from Benin, major components were 1,8-cineole (22.6%), sabinene (19.4%) and (*E*)- *β*-farnesene (%7.7). Hamid et al. (2010) found, in a study conducted in Nigeria, that the most abundantly found essential oils in leaves of *V. agnus-castus* in were detected as *β*-pinene (20.0%), viridifloral (9.8%), *α*-pinene (9.1%), cis-o-cymene (8.4%), 1,8 cineole (6.7%) and *β*-farnesene (5.4%). Galletti et al. (1996) extracted essential oils of leaves and fruits of the *V. agnus-castus* in South Italia and the highest components were defined as 1,8 cineol (35.2%), sabinene (23.6%), *α*-pinene (7.6%) in leaves; and *β*-farnesene (17.2%), *α*-terpinyl acetate (17.1%) and 1,8 cineole (15.1%) in fruits. Senatore et al. (2003) examined essential oils contents of fruits of white-flowered and purple-flowered *V. agnus-castus* collected from İçel/Turkey. The essential oils obtained from the fruit of the white-flowered plant contained 1,8-cineole (21.6%), caryophyllene (17.1%), sabinene (14.7%) and terpinen-4-ol (8.7%) at most, and the essential oil obtained from the fruit of the purple-flowered plant contained caryophyllene (30.9%), sabinene (15.1%), 1,8-cineole (13.1%) and (*E*)-*β*–farnesene (12.4%) at most. Toplan et al. (2015) examined the essential oils of *V. agnus-castus* fruits collected from Zonguldak, Edirne-Enez, Balıkesir-Antınoluk, Muğla-Bodrum, Antalya-Manavgat districts of Turkey. The essential oils obtained from the fruit of Zonguldak population contained *β*-caryophyllene (11.7%), *α*-pinene (10.0%), bicyclogermacrene (8.9%) at most, the essential oils obtained from the fruit of Edirne-Enez population contained bicyclogermacrene (22.1%), sabinene (7.8%), (*Z*)-*β*–farnesene (5.9%), 1,8-cineole (4.9%) at most, the essential oil obtained from the fruit of Balıkesir-Altınoluk population contained 1,8-cineole (17.3%), sabinene (15.4%), (*Z*)-*β*-farnesene (13.5%), bicyclogermacrene (12.1%) at most, the essential oils obtained from the fruit of Muğla-Bodrum population contained 1,8-cineole (13.2%), sabinene (12.8%), *β*-caryophyllene (12.7%), bicyclogermacrene (11.0%) at most, and the essential oils obtained from the fruit of Muğla-Bodrum population contained sabinene (12.1%), bicyclogermacrene (12.1%), 1.8-cineole (11.8%), *β*-caryophyllene (11.4%), (*Z*)-*β*–farnesene (9.4%) at most. Ulukanlı et al. (2015) detected 1,8 cineole (24.38%), sabinene (22.77%), *trans*-*β*-farnesene (8.50%) and *β*-caryophyllene (6.49%) at most in essential oils obtained from leaves of *V. agnus-castus* plant collected from Osmaniye district of Turkey. Ibrahim et al. (2009) examined essential oils contents of leaves *V. agnus-castus* collected from El-Sadat city, Menofyia Governorate, Egypt. The essential oils obtained from leaves *V. agnus-castus* major components trans caryophyllene (18.76%), 1,8-cineole (17.38%), sabinene (15.83%), germacrene B (13.72%). Katiraee et al. (2015) examined essential oils contents of leaves *V. agnus-castus* collected from Maraghe, East Azerbaijan province, Iran. The essential oils obtained from leaves *V. agnus-castus* major components *α*-pinene (19.48%), cyclohexene, 1-methyl-4-(1-methylethenyl) (13.37%), caryophyllene (8.55%), sabinene (6.89%), *β*-sesquiphellandrene (6.00%), phenol, bis(1,1-dimethylethyl) (4.09%) and camphene (3.59%). As a result of the study, most common obtained components were 1,8-cineole, propenamide, bicyclogermacrene, caryophyllene, sabinene, *N*-(4-fluorophenyl)-maleimide, *trans*-*β*-farnesene and *α*-pinene. Components obtained from a previous studies (Moudachirou et al. 1998; Senatore et al. 2003; Ibrahim et al. 2009; Hamid et al. 2010; Fakir et al. 2014; Eryiğit et al. 2015; Katiraee et al. 2015; Ulukanlı et al. 2015), were similar but their ratios were different than our study. This is could be explained by the fact that essential oil composition may have different quality and quantity under different geographical and environmental conditions, and also during the different periods of the plant growth (Mazandarani et al. 2013).

Table 1. Essential oil composition of *V. agnus-castus* fruits.

RT (min)	Component	Quantity (%)	RT (min)	Component	Quantity (%)
11.72	*α*-pinene	3.98	42.05	bicyclogermacrene	5.51
15.99	*β*-pinene	0.65	49.43	caryophyllene oxide	0.58
16.94	sabinene	5.37	50.49	ledol	1.05
19.14	*β*-myrcene	1.90	51.06	2-amino-5-hydroxy-acetophenone	0.86
19.83	*α*-terpinene	0.43	51.60	(-)-globulol	0.46
20.94	dl-limonene	2.59	52.82	(+) spathulenol	1.27
21.44	1,8-cineole	8.24	53.42	3,6-dihydropyrrolo[3,2-e]indazole-7,8-dione	0.68
21.49	*β*-phellandrene	0.99	53.86	*α*-farnesene	0.98
23.12	*γ*-terpinene	0.64	54.00	*α*-cadinol	1.03
23.44	1,3,6-octatriene	0.74	54.94	o-cymen-5-ol	1.97
24.35	benzene	0.83	55.45	isospathulenol	0.45
34.91	*α*-gurjenene	0.75	56.49	1-(3-methylbutyl)-2,3,5-trimethyl	1.79
37.58	caryophyllene	5.56	56.73	tricyclo(3,2,1,02,4) octane	0.41
38.74	*β*-sesquiphellandrene	0.68	60.01	*trans*-7,7-dimethyl-6-methylidene tricyclo[6,2,1,0]undecane	0.48
39.05	neoalloocimene	1.37	61.60	*N*-(4-fluorophenyl)-maleimide	5.28
39.41	*trans*-*β*-farnesene	4.45	63.02	3,7-dimethoxy-1-methyl xanthen-9-one	0.52
39.62	3-cyclohexene-1-methanol	0.46	63.89	propenamide	6.07
39.85	*α*-humulene	0.68	64.17	longiborn-9-ene	1.09
40.64	3-cyclohexene-1-methanol	1.72	70.11	9,9'-biphenanthrene	2.60
40.58	camphene	3.22	72.76	1,3-dimethyl-3-(3'-methylbut-2'-enyl)-1*H*-quinoline-2,4-dione	0.91
41.19	germacrene-D	1.69	91.69	germacrene D- 4- ol	0.49

RT: Retention time

4. Conclusion

Considering the current study with the essential oils from the fruits of *V. agnus castus* plants, the major components were detected as, 1,8 cineole (8.24%), propenamide (6.07%), caryophyllene (5.56%), bicyclogermacrene (5.51%), sabinene (5.37%), *N*-(4-fluorophenyl)-maleimide (5.28%), *trans*-*β*-farnesene (4.45%), *α*-pinene (3.98%). According to the results obtained in this study, these findings may be a valuable resource for further biotechnological, biodiversity, pharmaceutical and medicinal studies. It will also help to understand the importance of the biological diversity and conservation biology efforts.

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References

Baytop T. 1984. Türkiye'de Bitkiler ile Tedavi (Geçmiste ve Bugün). İ. Ü. Ecz. Fak. Yayınları (İlaveli İkinci Baskı), Nobel Tıp Kitapevleri, İstanbul.

Belic I, Bergant-Dolar J, Stucin D, Stucin M. 1958. Vestnik Sloven, Kemi Drustva 5: 63–67.

Bhattacharya TK, Ghosh MN, Subramanian SS. 1980. A Note on Antinflammatory Activity of Carpesterol. Fitoterapia, 51/5: 265–267.

Blamey M, Grey-Wilson C. 1998. Mediterranean Wild Flowers. HarperCollins Publisher, UK, London, p. 560.

Brickell C, Zuk JD. 1996. A-Z Encyclopedia of Garden Plants. DK Publishing Inc. New York, USA.

Burt S. 2004. Essential oils: their antibacterial properties and potential applications in foods- a review. International Journal of Food Microbiolology, 94: 223–253.

Cassiano B. 2007. Evaluation of *Origanum vulgare* essential oil as antimicrobial agent in sausage. Brazilian Journal of Microbiology 38/4: 610–616.

Chishti S, Kaloo ZA, Sultan P. 2013. Medical importance of genus *Origanum*: A review. Journal of Pharmacognosy and Phytotherapy, 5/10: 170–177.

Çetin B, Çakmakçı S, Çakmakçı R. 2011. The investigation of antimicrobial activity of thyme and oregano essential oils. Turkish Journal of Agriculture and Forestry, 35: 145–154.

Eryiğit T, Çig A, Okut N, Yıldırım B, Ekici K. 2015. Evaluation of Chemical Composition and Antimicrobial Activity of *Vitex agnus castus* L. Fruits' Essential Oils from West Anatolia, Turkey. Journal of Essential Oil Bearing Plants, 18/1: 208–214.

Fakir H, Erbaş S, Özen M, Dönmez İE. 2014. The Effects of Different Harvest Dates on Essential Oil Content and Composition in Chaste Tree (*Vitex agnus-castus* L.). European Journal of Science and Technology, 1/2: 25–28.

Galletti GC, Russo MT, Bocchini P. 1996. Essential Oil Composition of Leaves and Berries of *Vitex agnus-castus* L. from Calabria, Southern Italy, Rapid Communications In Mass Spectrometry, 10/11: 1345–1350.

Garnier G, Debraux G. 1961. Ressources Medicinalis de la Flora Francais. Vigot Freres Press, Paris.

Gianni S, Maietti S, Muzzoli M, Scaglianti M, Manfredini S, Radice M, Bruni R. 2005. Comparative evaluation of 11 essential oils of different origin as functional antioxidants, antiradicals and antimicrobials in foods. Food Chemistry, 91/4: 621–632.

Halaška M, Beles P, Gorkow C, Sieder C. 1999. Treatment of cyclical mastalgia with a solution containing a *Vitex agnus-castus* extract: Results of a placebo controlled double-blind study. Breast, 8/4: 175–181.

Hamid AA, Usman LA, Adebayo SA, Zubair MF, Elaigwu SE. 2010. Chemical Constituents of Leaf Essential Oil of North-central Nigerian Grown *Vitex agnus-castus*, Advances in Environmental Biology, 4/2: 250–253.

Holley RA, Patel D. 2005. Improvement in shelf-life and safety of perishable foods by plant essential oils and smoke antimicrobials. Food Microbiology, 22: 273–292.

Ibrahim N, Shalaby A, Farag R, Elbarotry G, Hassan E. 2009. Chemical Composition and Biological Evaluation of *Vitex agnus-castus* L. Medical and Aromatic Plant Science and Biotecnology, 3/1: 37–31.

Katiraee F, Mahmoudi R, Tahapour K, Hamidian G, Emami SJ. 2015. Biological Properties of *Vitex agnus-castus* Essential Oil (Phytochemical Component, Antioxidant and Antifungal Activity). Biotechnology and Health Sciences, 2/2:1–6.

Lucks BC, Sorensen J, Veal L. 2002. *Vitex agnus-castus* essential oil and menopausal balance: A self-care survey. *Complem.* Ther Nurs Midwifery, 8/3: 148–154.

Maltaş E, Uysal A, Yıldız S, Durak Y. 2010. Evaluation of Antioxidant and Antimicrobial Activity of *Vitex agnus-castus* L. Fresenius Enviromental Bulletin, 19/12b: 3094–3099.

Mazandarani M, Mirdeilami SZ, Pessarakli M. 2013. Essential oil composition and antibacterial activity of *Achillea millefolium* L. from different regions in north east of Iran. Journal of Medicinal Plants Research, 7/16:1063–1069.

Moudachirou M, Ayedoun MA, Sossou PV, Garneau FX, Gagnon H, Jean Fl. 1998. Chemical Composition of Leaf Oil of *Vitex agnus-castus* L. from Benin. Journal of Essential Oil Research, 10: 343–344.

Ormancy X, Sisalli S, Couliere P. 2001. Formulation of essential oils in functional perfumery. Perfumes, Cosmetiques, Actualities, 157: 30–40.

Pirigharnaei M, Heydari R, Zare S, Khara J, Eman-Ali Sazi R. 2012. Comparison of essential oil composition in wild and cultivated populations of *Thymus pubescens* Boiss. & Kotschy ex Celak. from Iran. International Journal of Plant Physiology and Biochemistry, 4/4: 92–98.

Rice-Evans C, Miller N, Paganga G. 1997. Antioxidant properties of phenolic compounds. Trends in Plant Science, 2/4:152–159.

Sawamura M. 2000. Aroma and functional properties of Japenese yuzu (*Citrus junos* Tanaka). essential oil. Aroma Research, 1/1:14–19.

Schellenberg R. 2001. Treatment for the premenstrual syndrome with agnus castus fruit extract: Prospective, randomized, placebo controlled study. BMJ 322: 134–137.

Senatore F, Napolitano F, Ozcan M. 2003. Chemical composition and antibacterial activity of essential oil from fruits of *Vitex agnus-castus* L. (Verbenaceae) growing in Turkey. Journal of Essential Oil Bearing Plants, 6/3: 185–190.

Toplan GG, Kürkçüoğlu M, Baser KHC, Sarıyar G. 2015. Composition of the essential oils from samples of *Vitex agnus-castus* L. growing in Turkey. Journal of Essential Oil Research, 27/4: 337-342.

Tümen G, Sekendiz AD. 1989. Balıkesir ve Merkez Köylerinde Halk ilaci Olarak Kullanılan Bitkiler. Uludağ Üniversitesi Araştırma Fonu, Proje No. 86/12.

Ulukanlı Z, Çenet M, Öztürk B, Bozok F, Karabörklü S, Demirci SC. 2015. Chemical Characterization, Phytotoxic, Antimicrobial and Insecticidal Activities of *Vitex agnus-castus*' Essential Oil from East Mediterranean Region. Journal of Essential Oil Bearing Plants, 18/6: 1500–1507.

Wuttke W, Jarry H, Christoffel V, Spengler B, Seidlova-Wuttke D. 2003. Chaste tree (*Vitex agnus-castus*)-Pharmacology and clinical indications. Phytomedicine, 10: 348–357.