CHEMICAL COMPOSITION AND ANTIFUNGAL ACTIVITY OF *Illicium verum* AND *Eugenia caryophyllata* ESSENTIAL OILS

Ana Dzamic,[1*] Marina Sokovic,[2] Mihailo S. Ristic,[3] Slavica Grijic-Jovanovic,[1] Jelena Vukojevic,[1] and Petar D. Marin[1]

UDC 547.913

Illicium verum Hook is native to southeast China, Vietnam, India, and Japan. The essential oil, rich in *trans*-anethole, is mainly used in the pharmaceutical and food industry [1]. Star anise oil exhibited high antioxidant activity [2], insecticidal activity, and fumigant [3] and antimicrobial potential [4]. *Eugenia caryophyllata* Thun. (syn. *Syzigium aromaticum* (L.) Merrill & Perry) grows wild in Indonesia and now is cultivated in the Philippines, the Molucca Islands, and Madagascar. This oil is extensively used as a flavor ingredient in food as well as in alcoholic and soft drinks [1]. Clove oil possesses strong antioxidative potential [5], and acaricidal [6], antifungal, antiviral, antitumor, and anesthetic activity [7].

In the present work, the essential oils of *I. verum* and *E. caryophyllata* were investigated as potential antifungal agents.

The results of chemical analysis of *I. verum* and *E. caryophyllata* essential oils are presented in Table 1. In the essential oil of *I. verum* 16 compounds were identified (99.55% of total oil). *trans*-Anethole was dominant (90.82%), followed by estragol (3.68%). Sixteen components were identified in the essential oil of clove, which represent 98.89% of total content. Eugenol (78.57%), β-caryophyllene (15.56%), and α-humulene (1.88%) were the main components in *E. caryophyllata* oil.

According to previously published reports [2, 4, 8], the essential oil from star anise fruit contains *trans*-anethole (94%), estragole, limonene, and *cis*-anethole. Dominant compounds in clove oils were eugenol, eugenylacetate, β-caryophyllene, and humulene [6–9].

TABLE 1. Chemical Composition (expressed as %) of *Illicium verum* and *Eugenia caryophyllata* Essential Oils

Components	KI	*I. verum*	*E. caryophyllata*	Components	KI	*I. verum*	*E. caryophyllata*
α-Pinene	939	0.13	-	Methyl eugenol	1403	-	0.12
α-Phellandrene	1005	0.11	-	β-Caryophyllene	1418	0.20	**15.56**
p-Cymene	1026	0.06	-	*trans*-α-Bergamotene	1435	0.17	0.24
Limonene	1031	0.67	-	α-Humulene	1455	-	1.88
Linalool	1097	0.79	-	δ-Cadinene	1522	-	0.07
Terpinen-4-ol	1177	0.12	-	Eugenylacetate	1523	-	0.50
α-Terpineole	1189	0.21	-	Caryophyllenyl alcohol	1572	-	0.24
Methyl salicylate	1190	-	0.05	Caryophyllene oxide	1583	-	0.47
Estragole	1195	3.68	-	Viridiflorol	1590		0.20
Chavicol	1247	-	0.12	Humulene epoxide	1606	-	0.14
cis-Anethole	1253	0.41	-	*trans*-Sesquilavandulol	1631	-	0.20
p-Anisaldehyde	1250	0.78	-	Alloaromadendrene epoxide	1639	-	0.25
trans-Anethole	1285	**90.82**	-	α-Muurolol	1641	0.07	-
Anisylacetone	-	0.24	-	4-Hydroxy-*cis*-caryophyllene	1666	-	0.20
Eugenol	1359	-	**78.57**	Foeniculin	1677	1.00	-
α-Copaene	1374	-	0.32	Total		99.55	98.89

KI: kovats index on DB-5 column.

1) University of Belgrade-Faculty of Biology, Institute of Botany and Botanical Garden "Jevremovac", Studentski trg 16, 11000 Belgrade, Serbia, e-mail: simicana@bfbot.bg.ac.yu; 2) Institute for Biological Research "Sinisa Stankovic", Bulevar Despota Stefana142, 11000 Belgrade, Serbia; 3) Institute for Medicinal Plant Research "Dr Josif Pancic", Tadeusa Koscuska 1, 11000 Belgrade, Serbia. Published in Khimiya Prirodnykh Soedinenii, No. 2, pp. 220–221, March–April, 2009. Original article submitted July 18, 2007.

0009-3130/09/4502-0259

TABLE 2. Antifungal Activity of *Illicium verum* and *Eugenia caryophyllata* Essential Oils, μL/mL

Fungi	*I. verum*		*E. caryophyllata*		Bifonazol	
	MIC	MFC	MIC	MFC	MIC	MFC
Alternaria alternata	2.5	2.5	0.25	0.25	10	10
Aspergillus niger	10	15	0.5	0.5	10	10
Aspergillus ochraceus	15	25	1	1	10	15
Aspergillus flavus	15	25	1	2.5	10	15
Aspergillus terreus	20	25	2.5	2.5	10	15
Aspergillus versicolor	15	20	0.5	1	10	10
Aureobasidium pullulans	2.5	2.5	0.25	0.25	5	10
Cladosporium cladosporioides	2.5	2.5	0.1	0.25	10	10
Cladosporium fulvium	2.5	5	0.1	0.1	5	10
Fusarium tricinctum	5	5	0.25	1	15	20
Fusarium sporotrichioides	5	5	0.5	1	15	20
Mucor mucedo	5	10	0.25	0.25	15	15
Penicillium funiculosum	10	25	0.5	0.5	15	20
Penicilium ochrochloron	10	25	0.5	0.5	15	20
Phomopsis helianthi	2.5	2.5	0.1	0.25	10	10
Phoma magdonaldii	2.5	5	0.25	0.25	10	15
Trichoderma viride	20	25	2.5	2.5	15	20
Trichphyton mentografites	5	10	0.5	0.5	10	15
Candida albicans	5	5	0.5	1	10	15

The antifungal activities of the tested oils are presented in Table 2. *I. verum* essential oil exhibited fungicidal characteristics with MIC and MFC of 2.5–25 μL/mL. *E. caryophyllata* oil showed strong antifungal activity. The fungistatic and fungicidal activity of its oil was 0.1–2.5 μL/mL. The most resistant fungi were *Trichoderma viride*, *Penicillium*, and *Aspergillus* species [10, 11].

The present study confirmed the antifungal activity of star anise and clove essential oil. The antimicrobial activity of star anise is mainly due to anethole [12]. Compounds with the phenolic structure, such as eugenol, are highly active against different microorganisms [9, 13]. Eugenol is responsible for the antifungal effect of clove oil, but the authors raised the possibility that interactive effects of the other compounds present in smaller quantities may also contribute [14]. The oils analyzed in this work, especially clove, showed powerful antifungal activity.

ACKNOWLEDGMENT

A. M. Dzamic, S. Drujic-Jovanovic and P. D. Marin are grateful to the Ministry of science and development protection of Serbia for the financial support (Grant. No. 1143049).

REFERENCES

1. J. Lawless, *The Encyclopaedia of Essential Oils*, Thorsons, London, 2002.
2. A. Padmashree, N. Roopa, A. D. Semwal, G. K. Sharma, G. Agathian, and A. S. Bawa, *Food Chem*., **104**, 59 (2007).
3. S-I. Kim, J-Y. Roh, D-H. Kim, H-S. Lee, and Y-J. Ahn, *J. Stored Prod. Res.*, **39**, 293 (2003).
4. G. Singh, S. Maurya, M. P. de Lampasona, and C. Catalan, *J. Sci. Food Agric.*, **86**, 111 (2006).
5. L. Jirovetz, G. Buchbauer, I. Stoilova, A. Stojanova, A. Krastanov, and E. Schmidt, *J. Agric. Food Chem.* **54**, 6303 (2006)
6. G. Fichi, F. Giovanelli, D. Otranto, and S. Perrucci, *Exp. Parasitol.*, **115**, 168 (2007)
7. K. Chaieb, H. Hajlaoui, T. Zmantar, A. B. Kahla-Nakbi, M. Rouabhia, K. Mahdouani, and A. Bakhrouf, *Phytother. Res*., **21**, 501 (2007).

8. G. Della Porta, R. Taddeo, E. D'Urso, and E. Reverchon, *Lebensm Wiss. Technol.*, **31**, 454 (1998).
9. M. A. Guynot, A. J. Ramos, L. Seto, P. Purroy, V. Sanchis, and S. Marin, *J. Appl. Microb.*, **94**, 893 (2003).
10. K. D. Daouk, M. S. Dagher, and J. E. Sattout, *J. Food Protect*. **58**, 1147 (1995).
11. H. Hanel and W. Raether, *Mycoses*, **31**, 148 (1988).
12. M. De, A. K. De, P. Sen, and A. B. Banerjee, *Phytother. Res.*, **16**, 94 (2002).
13. H. J. D. Dorman, and S. G. Deans, *J. App. Microbiol.*, **88**, 308 (2000).
14. L. B. Bullerman, F. Y. Lieu, and S. A. Seier, *J. Food Sci.,* **42**, 1107 (1977).