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COMPOSITION AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OILS OF SOME MEDICINAL AND SPICE PLANTS

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An examination was made on the chemical composition and antimicrobial activity of four medicinal plants *Carum carvi*, *Coriandrum sativum*, *Hyssopus officinalis,* and *Eucalyptus globulus*, the first three of which are also used as culinary spice herbs.

Carum carvi L. and *Coriandrum sativum* L. belong to the Apiacea family. In traditional medicine, *Carum carvi* is used in the form of a tea as a digestive and diuretic [1]. *Coriandrum sativum* has been used since ancient times; it was found in pharaonic tombs where it was used for embalming, and there is mention of it in the Bible. It is used as a medicine against flatulence and as a diuretic [1], and it also has an anticonvulsive effect [2]. The essential oils of these two plants are used as spices in preparing food.

Hyssopus officinalis L. and *Eucalyptus globulus* Lab. belong to the Lamiaceae and Myrtaceae families, respectively, and they are used in folk medicine to treat respiratory diseases [1].

The aim of this paper was to determine the chemical composition of the essential oils of the said plants and examine their activity against the growth of bacteria (*Staphylococcus aureus* ATCC 25923, *Streptococcus β haemolyticus* group A, *Escherichia coli* ATCC 25922, *Enterecoccus faecalis* ATCC 29212, and *Pseudomonas aeruginosa* ATCC 27853), and fungi (*Candida albicans* ATCC 10231). *Eucalyptus globulus* was collected at the Montenegrin Coast and all the rest of the plants were grown in the fields of Vojvodina (Northern Serbia).

The essential oils were obtained from the fruits of *Carum carvi* and *Coriandrum sativum* and the leaves of *Hyssopus officinalis* and *Eucalyptus globulus* by the steam distillation method following Procedure III of the Yugoslav Pharmacopoeia [3]. The GC and GC/MS analyses were used for determination of the essential oil composition. Percentages of the main components of the essential oils investigated are given in Table 1. The essential oils of the plants examined are of different chemical compositions, and monoterpenes are distributed the most. By comparison of the composition of the essential oils of the plants mentioned with the literature data [4] and [5], it was concluded that it was dependent on the geographic region and plant growing conditions.

The antimicrobial activity of the essential oils of the plants investigated was determined by the disc-diffusion method [6] and [7]. Tables 2 gives MIC (minimum inhibitory concentration) values and inhibition zone diameters for three different essential oil concentrations. The inhibition zone diameters were compared with the reference antibiotics, as shown in the tables. As *Enterecoccus faecalis* ATCC 29212and *Pseudomonas aeruginosa* ATCC 27853 were not inhibited by the essential oils of the plants mentioned, their results are not given in the Tables.

The broadest inhibitory activity spectrum was exhibited by the essential oils of *Carum carvi* and *Hyssopus officinalis*, and the narrowest one by *Eucalyptus globulus*. The antimicrobial activity of certain oils (*Carum carvi*, *Hyssopus officinalis*, and *Eucalyptus globulus*) against *Staphylococcus aureus* ATCC 25923 was higher than or equal to the reference value. A pronounced activity against *Candida albicans* ATCC 10231 was also expressed by all the essential oils with the exception of the essential oil of *Hyssopus officinalis*.

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TABLE 1. Main Components of the Essential Oils of the Plants Investigated

Compound	KI*	%	Compound	KI*	%
Carum carvi			*Coriandrum sativum*		
Limonene	1039	25.5	α-Pinene	936	5.6
Dihydrocarveol	1190	3.2	*p*-Cymene	1036	6.8
trans-Dihydrocarvone	1199	11.0	Limonene	1039	3.9
Carvone	1245	32.3	Linalool	1108	64.1
Carvacrol	1302	5.8	Camphor	1156	6.0
Caryophyllene	1414	5.0	Nerol	1226	4.2
Germacrene D	1472	14.0	Geranyl acetate	1379	1.8
Hyssopus officinalis			*Eucalyptus globulus*		
β-Pinene	977	4.9	α-Pinene	936	9.8
Pinocamphone	1160	15.3	Camphene	953	22.9
Borneol	1168	4.0	β-Pinene	977	3.5
Isopinocamphone	1173	46.1	*p*-Cymene	1034	2.3
Bornylacetate	1289	3.6	1,8-Cineole	1036	45.7
Germacrene-D-11-ol	1521	6.1	Limonene	1039	5.6
Elemol	1549	5.2	Globulol	1585	7.6

*KI: kovats index on DB-5 column.

TABLE 2. Antimicrobial Activity of the Essential Oil of *Carum carvi*, *Coriandrum sativum*, *Hyssopus officinalis*, and *Eucalyptus globulus*

Microorganisms	MIC µg/mL	Inhibition zone diameter, mm			Reference[a]		
		C1	C2	C3	T	H	N
Carum carvi							
Staphylococcus aureus ATCC 25923	209.2	27	17	11	30	27	0
Streptococcus β *haemolyticus* group A	217.2	20	16	0	24	28	0
Escherichia coli ATCC 25922	181.3	14	13	13	20	30	0
Candida albicans ATCC 10231	18.1	62	45	30	0	0	38
Coriandrum sativum							
Staphylococcus aureus ATCC 25923	288.4	15	11	0	30	27	0
Streptococcus β *haemolyticus* group A	218.5	18	14	0	24	28	0
Escherichia coli ATCC 25922	113.6	18	14	12	20	30	0
Candida albicans ATCC 10231	13.1	66	50	35	0	0	38
Hyssopus officinalis							
Staphylococcus aureus ATCC 25923	86.5	27	22	17	30	27	0
Streptococcus β *haemolyticus* group A	230.6	18	14	0	24	28	0
Escherichia coli ATCC 25922	96.1	18	15	14	20	30	0
Candida albicans ATCC 10231	9.6	20	20	20	0	0	37
Eucalyptus globulus							
Staphylococcus aureus ATCC 25923	91.5	29	20	15	30	27	0
Streptococcus β *haemolyticus* group A	> 2745	0	0	0	24	28	0
Escherichia coli ATCC 25922	219.6	17	13	0	20	30	0
Candida albicans ATCC 10231	9.2	28	25	20	0	0	35

C1: the concentrated essential oils, C2: essential oils diluted with absolute ethanol at the 1:1 rate, C3: essential oils diluted with absolute ethanol at the 1:3 rate; T: tetracycline 30 µg; H: chloramphenicol 30 µg; N: nistatin 25.5 µg (ICN Galenika).

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