

CHEMICAL COMPOSITION AND ANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL FROM *Daucus carota sativa* SEEDS

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Essential oils from many plants are known to exhibit antimicrobial activity that can act as a chemical protectant against pathogenic plant diseases [1, 2]. Essential oils (EO) from carrot seeds contain biologically active compounds [3, 4] and, although their biological activity has been known for a long time, the chemical composition and biological activity of essential oil from seeds of carrots growing in Uzbekistan have not yet been studied.

Commercially available carrot seeds (*Daucus carota sativa*, 100 g) were extracted for 4 h by steam distillation. The amber-colored essential oil was separated from water by ether and dried overnight over anhydrous Na₂SO₄ to afford essential oil in 2.2% yield.

The chemical composition of EO was studied by GC/MS on a Perkin—Elmer Turbo Mass Aid System XL gas chromatograph with a quadrupole mass spectrometer as the detector. We used a quartz capillary column (PE-5MS, 30 m × 0.25 mm) with a deposited stationary phase of copolymer (5% phenylmethylsilicone) 0.25 μm thick. The He carrier gas flow rate was 1 mL/min. The column temperature thermostat was programmed as follows: hold for 2 min at 75°C, heat to 100°C at 2°C/min, to 160°C at 4°C/min; and to 220°C at 2°C/min; hold at this temperature for 2 min. The duration of the final isothermal regime was 20 min at 230°C. Samples (0.2 μL) were injected with vaporizer temperature 180°C, detector 220°C, ionization potential 70 eV, and *m/z* 30-550.

The contents of EO components were calculated using GC peak areas without correlation coefficients. Components were identified based on a comparison of retention times and full mass spectra with those of standard EO components and pure compounds and a search of the NBS, NIST, and Wiley mass spectrometric libraries.

A total of 18 chemical components consisting of 99.98% of the EO were identified in seeds of *Daucus carota sativa*. According to the GC/MS results, the main components of carrot-seed EO were β-bisabolene (80.49%), α-asarone (8.8%), and *cis*-α-bergamoten (5.51%). The total amount of main components was 95.72% of the total EO content.

Table 1 gives the chemical components and their molecular formulas and relative percent contents according to the mass spectrometric analyses.

The main components of carrot-seed EO from France and Hungary were α-pinene (13%), β-pinene (18%), carotol (18%), and β-bisabolene [5, 6]. However, the main components of EO from Uzbekistan were β-bisabolene (80.49%), asarone (8.8%), and *cis*-α-bergamoten (5.51%). The variation in the EO component compositions is probably due to growing conditions.

The antiicrobial activity of the EO fractions against *Candida albican* and *Staphylococcus aureus* was determined by a modified Barry test method [7]. Table 2 gives the results.

Table 2 shows that mixtures of terpenes and sesquiterpenes from carrot-seed EO exhibited a high antimicrobial activity and possibly protect seeds from bacterial and fungal infection. Pure α-asarone exhibited sedative and antipyretic properties; α-humulene, anticancer activity against MCF-7, PC-3, A-549, DLD-1, M4BEU, and CT-26 tumor cells [8]. According to the results, carrot-seed EO is a valuable natural substance and an object for investigation of further practical applications.

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TABLE 1. Chemical Composition of Essential Oil from Seeds of *Daucus carota sativa*

Component	Formula	MW	Content, %	Component	Formula	MW	Content, %
<i>cis</i> - α -Bergamoten	C ₁₅ H ₂₄	204	5.51	α -Farnesene	C ₁₅ H ₂₄	204	0.52
Caryophyllene	C ₁₅ H ₂₄	204	0.21	Lanceol	C ₁₅ H ₂₄ O	220	0.43
β -Sesquiphellandrene	C ₁₅ H ₂₄	204	0.13	Methylisoeugenol	C ₁₁ H ₁₄ O ₂	178	0.07
β -Bisabolene	C ₁₅ H ₂₄	204	80.49	Spatulenol	C ₁₅ H ₂₄ O	220	0.49
α -Humulene	C ₁₅ H ₂₄	204	0.46	α -Bisabolol	C ₁₅ H ₂₆ O	222	0.07
<i>trans</i> -Anethole	C ₁₀ H ₁₂ O	148	0.09	α -Bergamoten	C ₁₅ H ₂₄	204	0.09
Caryophyllene oxide	C ₁₅ H ₂₄ O	220	0.23	Bisabolene	C ₁₅ H ₂₄	204	0.54
<i>p</i> -Menth-1(7),8(10)-dien-9-ol	C ₁₀ H ₁₆ O	152	0.32	2,6,10-Dodecatrien-1-ol 3,7,11-trimethyl	C ₁₅ H ₂₆ O	222	0.83
Carotol	C ₁₅ H ₂₆ O	152	0.32	α -Asarone	C ₁₂ H ₁₆ O ₃	152	8.82

TABLE 2. Antimicrobial Activity of *Daucus carota sativa* Essential Oil*

Microorganism	Dilution	MIC, mg/mL	MEC, mg/mL
<i>Candida albican</i>	1:32	15.63	-
	1:16	-	31.25
<i>Staphylococcus aureus</i>	1:512	0.976	-
	1:256	-	1.95

*After 48 h incubation at 30°C.

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