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FATTY ACID AND VOLATILE OIL COMPOSITION OF DIFFERENT CORIANDER (*Coriandrum sativum*) REGISTERED VARIETIES CULTIVATED IN TURKEY

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Coriandrum sativum L., belonging to the family Umbelliferae (Apiaceae), is a strong smelling annual herb. It is mainly cultivated for the seeds, whereas the leaves are used as a garnish. Coriander seeds (fruits) are widely used as a seasoning agent in liqueurs, teas, meat products, and pickles, as well as pastry, cookies, buns, and tobacco products [1]. Moreover, the ground seed is a major ingredient (10–50%) in curry powder used in cooking all over the world [2].

There is 0.3–1.2% essential oil in the seeds, and 60–70% of this essential oil is linalool, which gives the pleasant characteristic odor to the oil. Linalool, a terpene tertiary alcohol, is reported to have antioxidant potency at high concentrations [3, 4]. The volatile oil of coriander is utilized in different branches of the food industry such as bakery, meat processing, and chewing gum production. This oil is also extensively used in perfumery and in the cosmetic industry for its powerful aroma [5, 6], and in the pharmaceutical industry for its antibacterial, bacteriostatic, fungicidal, and insecticidal activities [7, 8]. Furthermore the seeds contain 19–21% of fatty oil having a dark, brownish green color and an odor similar to that of coriander seeds. The seed oil is used in perfumes, cosmetics, and soaps [9]. Petroselinic acid (18:1 n-12), a characteristic fatty acid of the seeds of the *Apiaceae*, is the main (up to 80%) storage fatty acid in the seed [10]. It was reported that dietary petroselinic acid, which is present at a high level in coriander oil, was found to strongly reduce the level of arachidonic acid in the heart [11] and liver [11, 12]. Fatty acids play a vital role in the functional activities of the human body.

Coriander is classified into two varieties according to fruit size, namely *Coriandrum sativum* var. *vulgare* (large fruit) and *Coriandrum sativum* var. *microcarpa* (small fruit). There is a correlation between essential oil yield and fruit size in coriander. Small fruit has higher percentage of essential oil than large fruit. It is known that large seeded varieties are crushed for use as a spice while the small seeded varieties are used to supply essential oils.

These new varieties of coriander were cultivated and registered by the Field Crops Department, Faculty of Agriculture, in Ankara University in 2005 as Arslan and Gurbuz. Varieties Arslan and Gurbuz belong to *Coriandrum sativum* var. *vulgare* and *Coriandrum sativum* var. *microcarpa*, respectively. Both varieties were registered because of their high seed yield and winter resistance. The aim of this study was to investigate the differences between yields and compositions of oil and essential oil of the control (*Coriandrum sativum* L.) and two registered varieties.

Coriander seeds were finely ground with a hand mill, and the oil was extracted with *n*-hexane in a Soxhlet extractor for 5 h. The recovered crude oils were dried on a rotator at 35°C. After determination of the oil yield (in the dry matter), the fatty acids were esterified as methyl esters and analyzed by Thermo Quest Trace 2000 GC equipped with a DB-23 capillary column (60 m $\times$ 0.25 μm) and an FID detector. Helium was used as carrier gas at a flow rate of 1 mL/min. Injector and detector temperatures were 250°C. Column temperature was kept at 185°C for 60 min. Samples of 0.5 μL were injected by hand and in the split mode (1:80). Fatty acids were identified by comparison with fatty acid methyl ester standards.

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TABLE 1. Fatty Acid Composition of Coriander Seeds, %

Fatty acid	Control	var. Gurbuz	var. Arslan	LSD	Fatty acid	Control	var. Gurbuz	var. Arslan	LSD
14:0	0.03	0.08	0.03	0.1189**	18:2	14.76	17.37	14.97	1.617**
16:0	3.74	5.18	3.88	1.058*	18:3	0.18	0.43	0.32	0.1434*
18:0	0.97	0.80	0.96	0.1189**	20:0	0.08	0.11	0.07	ns
18:1 (n-12)	77.10	72.32	76.31	2.490*	20:1	0.21	0.27	0.19	ns
18:1 (n-9)	2.94	3.44	3.26	ns					

LSD: least significant difference (**P<0.01; *P<0.05; ns: not significant).

TABLE 2. Essential Oil Composition of Coriander Seeds, %

Compounds	Rt	Control	var. Gurbuz	var. Arslan	LSD
α-Pinene	8.63	1.43	3.06	2.89	0.7704**
Camphene	9.19	0.12	0.28	0.31	0.1189**
Sabinene	10.25	0.10	0.10	0.14	ns
β-Pinene	10.35	0.15	0.25	0.21	ns
Myrcene	11.06	0.31	0.42	0.46	0.1189**
Δ^3-Carene	14.09	3.88	5.27	7.98	0.248**
α-Terpinene	15.43	0.21	0.20	0.22	ns
Linalool	16.41	82.65	75.26	69.31	1.891**
Camphor	18.04	3.18	3.56	4.03	0.4419*
Terpinen-4-ol	19.59	0.38	0.38	0.46	0.0717*
α-Terpineol	20.23	0.43	0.39	0.37	ns
n-Decanal	20.98	0.11	0.54	1.74	0.1189**
Geraniol	23.25	2.60	2.37	2.53	ns
Geranyl acetate	28.94	1.86	2.77	1.44	0.9658**
Caryophyllene oxide	36.87	0.25	0.74	0.51	0.1189**

Rt: (min) retention time of peak on the HP-5 column.
LSD: least significant difference (**P<0.01; *P<0.05; ns: not significant).

The fatty acid composition of samples is shown in Table 1. Gurbuz gave a richer oil yield (10.60%), and the percentages of all fatty acids were higher except for stearic (18:0) and petroselinic acids (18:1 n-12). While the level of petroselinic acid, the major fatty acid of coriander, was observed to be lower in Gurbuz (72.32%) compared to the control and Arslan, this amount is still within the range determined in a previous study (67.1–73.0%) [13]. There is no significant difference between the total oil yield and the main fatty acids of the control and Arslan.

The results of GC–MS analysis of the essential oils of the varieties are presented in Table 2. Gurbuz was observed to have significantly higher content of essential oil (0.65%) compared to the others. The present report is in agreement with previous reports which have also shown that small fruits have higher essential oil content. Fifteen compounds were identified in the essential oil of coriander varieties. The most important component of the essential oil was linalool, which amounts to more than 70% in all samples as stated in other reports [14].

Additionally, the other main components are Δ^3-carene, camphor, α-pinene, geraniol, and geranyl acetate in our work. The highest values of Δ^3-carene (7.98%), camphor (4.03%), terpinen-4-ol (0.46%), and *n*-decanal (1.74%) were obtained in Arslan, while the linalool value (69.31%) was the lowest in this variety.

In conclusion, significant differences were observed between the two varieties of coriander. It is concluded that var. Gurbuz has higher oil and essential oil levels. Therefore, it might be cultivated and used in different industries due to its oil yield. However, the linalool content of this variety was determined to be lower than that of control and higher than that of Arslan.

The coriander varieties (Arslan and Gurbuz) were cultivated under the same field conditions in 2005. Harvested seeds were stored at ambient temperature. Coriander population was used as the control.

The powdered coriander seeds were hydrodistilled for 3 h using a Clevenger apparatus, and the yields were calculated. The essential oils were dried over anhydrous sodium sulfate and stored at +4°C. The analysis was performed using a Hewlett Packard 6890 N GC, equipped with an HP-5 MS capillary column (30 m $\times$ 0.25 μm) and HP 5973 mass selective detector. For GC-MS detection an electron ionization system with ionization energy of 70 eV was used. Helium was used as carrier gas at a flow rate of 1 mL/min. Injector and MS transfer line temperature were set at 220 and 290°C, respectively. Column temperature was initially kept at 50°C for 3 min, then gradually increased to 150°C at a 3°C/min rate, held for 10 min, and finally raised to 250°C at 10°C/min. Diluted samples (1:10 in hexane, v/v) of 1 μL were injected automatically and in the splitless mode. Individual components were identified by spectrometric analyses using the computer library [15].

Data were analyzed using random block design by the MSTAT program. All analyses were performed in three replicates.

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