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STUDIES ON THE ESSENTIAL OILS OF THE PAKISTANI SPECIES OF THE FAMILY UMBELLIFERAE

Part XXVIII *Coriandrum sativum* Linn. (Coriander, Dhania) Oil of the Seeds and the Whole Plant

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The essential oil obtained from the seed and the whole plant of *Coriandrum sativum* has been investigated for its physicochemical properties and chemical composition. The oil from the seed cultivated in these Laboratories (0.5%) and also from the one purchased in the local market (0.3%) consists of α–pinene (1.3, 0.5%), camphene (1.1, 0.8%), myrcene (0.3,0.2%), Δ^3–carene (0.6, 0.2%), α–phellandrene (0.5, 0.3%)limonene (3.1, 3.1%), γ–terpinene (7.3, 3.2%), *p*-cymene (2.2, 1.0%), an unknown monoterpene (0.6, 0.7%) linalyl acetate (5.1, 3.2%), geranyl acetate (3.3, 7.9%) an unidentified ester (0.0, 1.2%), linalool (70.0, 68.0%), geraniol (3.1, 9.5%) and borneol (1.5, 0.0%) respectively. The whole plant before the flowering stage and at the flowering stage with 0.001 and 0.002% oil contents respectively, however, containe α–pinene (0.9, 0.8%), camphene (1.2, 2.6%), myrcene (0.8, 0.9), Δ^3–carene (0.3, 0.9%), α–phellandrene (1.2, 1.4%), limonene (0.9, 0.8%), *p*-cymene (1.0, 0.9%), unidentified monoterpenes (0.2, 1.4%), nonanal (16.2, 20.6%), 2-decanol (18.0, 37.5%), unidentified esters (6.7, 0.0%), an unknown hydroxy compound (10.6, 9.6%), a 5-membered cyclic ketone (38.3,18.2%) and coumarins (3.5, 4.4%).

Coriandrum sativum is a common cultivated plant in Pakistan and its fruits and leaves are used as a spice. The fruits are also used in digestive ailments and are good bacteriocidal and fungicidal.

INTRODUCTION

Coriandrum is a genus of the Mediterranean region with three species. The plants are annual herbs. Only one species namely *Coriandrum sativum* occurs in Pakistan.

Coriandrum sativum is a commonly cultivated plant in the plains and hills of Pakistan. The fruit of the species are diuretic, antipyretic, aphrodisiac, stimulant, laxative and anthelmintic. The leaves of the species are hypnotic, analgesic, tonic and carminative. The essential oil of the species is widely used in gin essences and for flavouring of canned soups and food, spicy sauces, baked goods and confectionary; it is also used in pharmaceutical and other preparations for covering disagreeable odour and taste.

These investigations have been undertaken with a view to highlighting the quality and chemical composition of the species. These are the first ever studies as regards the indigenous speices.

EXPERIMENTAL

Materials and Methods

Mature seeds of *Coriandrum sativum* were purchased from the local market for these studies. The seeds were also grown in these Laboratories to study the species at different stages of cultivation.

The oil from the seeds as well as from the plant of the species was steam-distilled according to the standard procedure [1]. The general methods employed for these studies have already been communicated in our earlier publications [1,2].

Analysis of the Oil. The oil was split into hydrocarbon fraction and oxygenated components by column chromatography using silica gel as an adsorbent. The hydrocarbon fraction of the oil was eluted with n-hexane and further resolved into individual components by GLC using a 3 mm × 3 m copper column packed with 7.5% Carbowax on Chromosorb, nitrogen as the carrier gas and flame ionisation detector. The column temperature was maintained at 120°. The oxygenated components of the oil were separated by column chromatography using 1–50% diethyl ether in n-hexane. The more polar and strongly adsorbed constituents of the oil were, however, eluted from the column with 100% diethyl ether. The various oxygenated components were identified by IR comparison and also by conversion into their known derivatives.

Table 1. Percentage yield and physicochemical properties of the essential oil of Pakistani *Coriandrum sativum* and a comparison of these values with those of the oils of other countries.

Country	Yield (%)	Specific gravity	Refractive index	Optical rotation	Acid value	Ester value	Ester value after acetylation
Pakistan							
Purchased seed	0.30	$0.8480^{19.5}$	$1.4669^{19.5}$	$+7^{\circ}\ 16'^{19.5}$	9.30	37.30	131.80
Cultivated seed	0.50	0.8530^{18}	1.4701^{18}	$+8^{\circ}\ 32'^{19.5}$	8.80	30.60	126.30
Whole plant before flowering stage	0.001	0.9200^{34}	1.4670^{34}	–	–	–	–
Whole plant at flowering stage	0.002	0.8096^{34}	1.4540^{34}	$-22^{\circ}44'^{34}$	16.30	26.30	–
Czechoslovakia[3] (seed)	–	0.7810^{20}	1.4644^{22}	$+10^{\circ}36'^{32}$	1.80	16.40	–
England (seed)[3]	–	0.8720^{20}	1.4841^{20}	$+10^{\circ}48'^{32}$	0.82	12.40	–
Hungary (seed)[3]	–	0.8710^{20}	1.4644^{20}	$+10^{\circ}36'^{32}$	0.86	13.00	–
Morocco (seed)[3]	–	0.8730^{20}	1.4658^{20}	$+\ 9^{\circ}30'^{32}$	1.63	19.70	–
Poland (seed)[3]	–	0.8643^{20}	1.4643^{20}	$+10^{\circ}24'^{32}$	2.10	11.50	–
Roumania (seed)[3]	–	0.8710^{20}	1.4648^{20}	$+\ 9^{\circ}36'^{32}$	1.47	6.10	–
Russia (seed)[3]	–	0.8630 to 0.8750	1.4630 to 1.4661	$+\ 9^{\circ}30'$ to $+11^{\circ}\ 6'$	–	–	–

The superscripts indicate the temperature at which these parameters were determined.

Table 2. Percentage composition of the essential oil of *Coriandrum sativum* seed and whole plant.

Constituent	Oil recovered from			
	Purchased seed (%)	Cultivated seed (%)	Whole plant before flowering stage (%)	Whole plant at flowering stage (%)
Unidentified monoterpene	0.8	0.6	0.2	1.4
α-Pinene	0.5	1.3	0.9	0.8
Camphene	0.9	1.1	1.2	2.6
Myrcene	0.2	0.3	0.8	0.9
Δ^3-Carene	0.2	0.6	0.3	0.9
α-Phenllandrene	0.3	0.5	1.2	1.4
Limonene	3.1	3.1	0.9	0.8
γ-Terpinene	3.2	7.3	–	–
p-Cymene	0.9	2.2	1.0	0.9
Linalyl acetate	3.2	5.1	–	–
Geranyl acetate	7.9	3.3	–	–
Unknown ester	1.2	–	6.7	–
Linalool	68.0	70.0	–	–
Geraniol	9.6	3.1	–	–
Borneol	–	1.5	–	–
Nonanal	–	–	16.2	20.6
2-Decanol	–	–	18.2	37.5
Unknown hydroxy compound (solid)	–	–	10.6	9.6
5-Membered cyclic ketone	–	–	38.3	18.2
Coumarins	–	–	3.5	4.4

RESULTS

The physicochemical properties of the essential oils obtained from the seeds as well as from the whole plant are recorded in Table 1. A comparison of these values with those of the Coriander oils of some other countries is also shown in Table 1. The chemical composition of the seeds and that of the whole plant is given in Table 2.

DISCUSSION

The physicochemical values as well as the chemical composition of the essential oils obtained from the seeds and the whole plant are quite different from each other. The hydrocarbon fractions of both the oils, however, contain identical monoterpenes but different in proportion; only γ-terpinene has been found absent in the essential oil of the whole plant. No sesquiterpene was detected in these oils.

The major oxygenated components of the essential oils from the seeds consisted of terpenic alcohols namely linalool and geraniol while the oil obtained from the whole plant is free from these alcohols. The seed essential oil also contains linalyl acetate and geranyl acetate; the other major oxygenated components which are also absent from the whole plant essential oil. The whole plant essential oil is, however, rich in carbonylic compounds such as nonanal and 2-decanal.

Qualitatively, the essential oil of the *Coriandrum sativum* is as good as those produced elsewhere in the world [3]. The results of the present studies are in good agreement with the earlier work [3]. The oil can, therefore, find all the recorded applications and the species can become an important raw material of the country.

The essential oil from the seeds of the species has been found very active against *Staphylococcus aureus* and *Sarcina lutea* as bacteriocidal and *Penicillium, Aspergillus niger* and *Mucor* as fungicidal. The species can, therefore, be used as preservative of food.

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