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

Part XXIV. Ferula costata (Ghuttai) Seed Oil

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Abstract. The essential oil from the fresh seed of the *Ferula costata*, growing wild in Pakistan, has been characterized and studied with respect to its physico-chemical properties and chemical composition. The percentage composition of the oil as determined by time and temperature programmed GLC has been found to contain α-pinene (0.85%), β-pinene (0.73%), myrcene (0.25%), limonene (0.33%), δ-cadinene (1.50%), γ-candinene (1.00%), isolongifolene (0.84%), β-elemene (1.15%), β-caryophyllene (11.70%), humulene (5.26%), unknown sesquiterpenes (8.29%), ledol (1.84%), unknown alcohol (1.66%), guaiol (1.15%), torryol (7.15%), elemol (2.20%), cedrol (5.80%), cadinol (7.40%), δ-cadinol (10.70%) and farnesol (30.20%). In spite of the best efforts, no sulphur bearing compound has been detected in the essential oil of this *Ferula* species.

Introduction

Ferula costata is native to Pakistan and Afghanistan. In Pakistan, it grows wild in Urak and Loralai in Baluchistan. Its seeds have been observed to be stimulant, carminative, antispasmodic, expectorant, laxative, diuretic, anthelmintic, aphradisiac and ocular tonic. The gum of the species is used as flavouring agent.

No work has so far been reported in literature on the essential oil of this species. The present studies have, therefore, been undertaken for obtaining basic information for use in developing new plant of essential oils in Pakistan.

Materials and Methods

Fresh and mature seeds of the *Ferula costate* were hand-collected from Urak. The essential oil from the crushed material was separated by the usual rocedure of dry steam distillation.[1] The general methods used for these studies have been described in our earlier papers.[1,2] In addition, a time and temperature programmed GLC coupled with mass spectrometry was used to analyze the oil.

Chromatographic Analysis of the Oil. As usual, the essential oil was column-chromatographed using silica gel as an adsorbent. The hydrocarbon fraction of the oil, as eluted from the column with *n*-hexane, was further resolved into individual constituents by GLC. Column chromatography proved ineffective in the resolution of the oxygenated fraction of the oil which consisted of a mixture of sesquiterpenic alcohols. The oil was, therefore, examined by time and temperature programmed GLC using a glass column (0".25 × 6') packed with 3% Silar 5cp and the various constituents were identified from the computerized data of mass spectrometry.

Results

The percentage yield, physico-chemical values and the chemical composition of the essential oil of *Ferula costata* are recorded in Tables 1-2. Resolution of the oil by time and temperature programmed GLC is shown in Fig. 1.

TABLE 1. PERCENTAGE YIELD AND PHYSICO-CHEMICAL VALUES OF THE ESSENTIAL OIL OF FERULA COSTATA SEED.

Distillation time	16 hr.
Yield of oil	2.4%
Specific gravity	0.9292^{15}
Refractive index	1.5060^{15}
Optical rotation	$-24°32'^{15}$
Acid value	0.17
Ester value	3.78
Ester value after acetylation	55.26

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

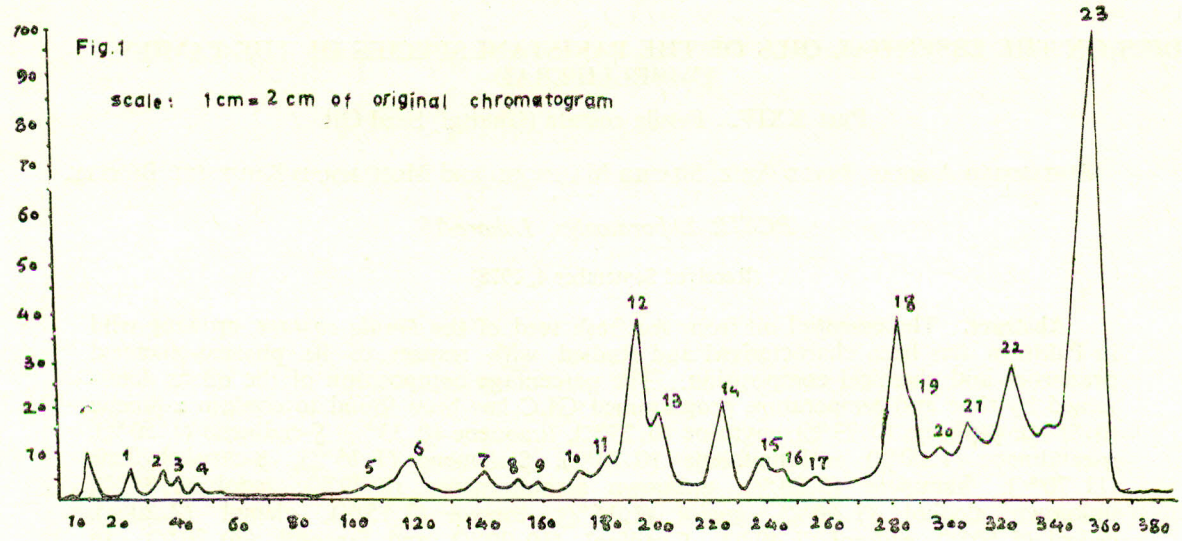

TABLE 2. PERCENTAGE COMPOSITION OF THE ESSENTIAL OIL OF FERULA COSTATA SEED BY (TIME AND TEMPERATURE) GLC PROGRAMMING

Component	Percentage
α-Pinene	0.85
β-Pinene	0.73
Myrcene	0.25
Limonene	0.33
Unknown sesquiterpene	0.20
δ-Cadinene	1.50
γ-Cadinene	1.00
Isolongefolene	0.84
β Elemene	1.15
Unknown sesquiterpene	1.21
,,	2.70
β Caryophyllene	11.70
Unknown sesquiterpene	4.18
Humulene	5.26
Ledol	1.84
Unknown alcohol	1.66
Guaoil	1.15
Torryol	7.15
Elemol	2.20
Cedrol	5.80
Cadinol	7.40
δ-Cadinol	10.70
Farnesol	30.20

Discussion

The essential oil from the seeds of *F. costata* is reasonably good to smell. The hydrocarbon fraction of the oil is mainly composed of sesquiterpenes, β-caryophyllene being the major component of the fraction. Identification of these compounds was carried out by GLC/MS and also by GLC comparison method.

The oxygenated fraction (≃68%) of the oil predominantly consisted of saturated sesquiterpenic tertiary alcohols as shown by chemical examination. These alcohols were identified from the computerized data of GLC/MS and also by GLC comparison method. However, the identification of guaiol is tentative depending solely on the GLC/MS data.

The physico-chemical values of the essential oil of *Ferula costata* closely resembles those of the essential oil of *F. foetida*[3] but there is some difference in their chemical composition. The essential oil of *F. costata* does not contain any ester, ketone or phenol while bornyl acetate, fenchone and eugenol have been identified in the essential oil of *F. foetida*. However, both these oils contain a considerable amount of sesquiterpenic alcohols. Farnesol, cadinol and guaiol, the major components of the two oils, have been found as the common constitutents of the oils.

The present studies indicate that the essential oil of *F. costata*, like that of *F. foetida*, can become a good substitute for galbanum essential oil. Because of similarity in their major constituents the former can find application in various diseases like the latter.[4] The species under investigation can, therefore, become a useful item of commerce.

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