

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

Part XLV. *Ferula assafoetida*, Linn (Herra Hing) Gum Oil

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(Received September 24, 1979)

The essential oil steam-distilled from the pure gum of *Ferula assafoetida* originating from the Baluchistan Province in Pakistan has been studied with respect to its physicochemical characteristics and chemical composition. The oil is obtained from the gum in 20.74% yield and has been found to be composed of α -pinene (14.3%), phellandrene (6.4%), secondary butyl propenyl bisulphide (51.9%), undecyl sulphonyl acetic acid (18.8%), an unidentified bisulphide (7.5%) and tarry material (1.0%). The essential oil possesses garlic-like flavour and it can be used in place of its gum which finds application in the preparation of some local dishes besides its unique medicinal value.

INTRODUCTION

Ferula is the largest genus in the Umbelliferae consisting of 140 species from the Mediterranean regions to the Central Asia. Most of these plants are reported to grow in the USSR and its adjacent regions. Pakistan is inherited only 16 species of the genus *Ferula*. The plants grow wild and are perennial herbs.

Ferula assafoetida is native to Afghanistan and Iran. The plant exudes a gum which finds wide applications as a medicine [1,2]. The gum is one of the most important species used in small quantities in most of the Indian cooking. It has since long been used in the local materia medica as stimulant, carminative, antispasmodic, expectorant, laxative, diuretic, anthelmintic, aphrodisiac, emmenagogue and vision improver. It is employed as a flavouring for sauces and other foods and for the cure of hypochondriasis. The oil of the gum has been found effective against *Staphylococcus aureus*, *Streptococcus faecalis* and *Sarcina lutea* [3].

The present investigations deal with the essential oil of the *Ferula assafoetida* gum to study its quality and chemical composition in view of exploiting the indigenous raw material of the country.

MATERIALS AND METHODS

Ferula assafoetida gum was obtained from the Quetta market where it is sold under the name of 'Herra Hing'. The essential oil from the gum was recovered by dry steam-distillation according to the standard procedure [4]. The general methods used for the analysis of the oil have

been reported in our earlier work [4,5].

The oil was column-chromatographed using silica gel as an adsorbent. The hydrocarbon fraction of the oil was recovered with n-hexane which was further resolved into individual components by GLC using a stainless-steel column (3 mm x 3m), nitrogen as the carrier gas and flame ionization detector. The column was operated at 110° and 175° for the resolution and identification of monoterpenes and sesquiterpenes respectively. The oxygenated components of the oil were eluted from the column with 2-10% diethyl ether in n-hexane. Identification of these compounds was carried out by IR comparison with their standard spectra and also by chemical methods.

RESULTS

The percentage yield, physicochemical values and chemical composition of the essential oil of *Ferula assafoetida* gum are recorded in Tables 1 - 2.

Table 1. Percentage yield and physicochemical values of the essential oil of *Ferula assafoetida* gum.

Distillation time (hr)	14
Yield of the oil (%)	20.74
Specific gravity	0.9936 ³³
Refractive index	1.5240 ³³
Optical rotation	-7° 11' ³³
Acid value	2.33
Ester value	31.49
Ester value after acetylation	16.94

Superscripts indicate the temperature at which these parameters were determined.

Table 2. Percentage composition of the essential oil of *Ferula assafoetida* gum.

Composition	Percentage
α -Pinene	14.3
Phellandrene	6.4
Secondary butyl propenyl disulphide	51.9
Undecyl sulphonyl acetic acid	18.8
Unknown bisulphide	7.5
Tarry material	1.0
Unrecovered material	0.1

DISCUSSION

The characteristic strong odour of *Ferula assafoetida* gum is essentially due to the volatile oil present in it and, therefore, the quality of the gum may be expected to depend largely upon the content and composition of the volatile constituents. The gum of *Ferula assafoetida* generally available in the market is compounded one which is prepared by mixing the pure gum with either the resinous matter of other species or some additives just to increase the weight. The percentage yield of the essential oil in the pure gum was found to be about 25 times the amount of essential oil in the compounded gum. A comparison of the physicochemical constants of the two oils, however, shows that the essential oils from the two samples do not differ much.

The hydrocarbon fraction of the oil gave one major and one minor peak in the chromatogram. The major peak was identified as α -pinene and the minor one as phellandrene. No sesquiterpene was detected in the fraction under the conditions described earlier.

The oil was chiefly composed of sulphur-bearing compounds. The column when eluted with 2% diethyl ether in n-hexane gave a single compound amounting to 51.9% of the total oil. The compound was identified as secondary butyl propenyl disulphide by its IR:s (3.4, 6.3, 7.0, 8.3,

10.8 nm), m(7.3, 8.7, 13.2 nm), w(7.5, 7.7, 9.9, 10.1, 11.2, 14.3 nm). This compound has already been reported to be the major constituent of the essential oil of *Ferula assafoetida* gum.

Elution of the column with 3% diethyl ether in n-hexane gave another single compound by TLC. It was identified as undecyl sulphonyl acetic acid by IR:s (5.9, 7.0, 7.6, 7.9, 8.7, 8.9, 11.0 nm), m(2.9, 6.8, 7.2, 12.2, 14.4 nm), w(9.3, 9.8, 13.1, 13.8 nm) comparison with the standard spectrum of the compound.

The column was then eluted with 10% diethyl ether in n-hexane which gave a disulphide type of compound by IR and chemical test. Identification of the compound has yet to be carried out. The column was finally washed with 100% diethyl ether but the fraction thus obtained consisted of tarry material.

The present study indicates that the essential oil from the gum of *Ferula assafoetida* constitutes almost all the components which has already been reported [1].

Acknowledgements. We are grateful to the United States Department of Agriculture for financing this research work under PL-480 scheme and to Mr. Abdul Waheed Sabir, our Botanist, for the identification and procurement of authentic material for this work.

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