

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

Part XLVII. *Angelica archangelica*, Linn. var. *Himalaica* (Clarke), E. Nasir, Seed Oil

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A study upon the physicochemical characteristics and chemical composition of the essential oil distilled from the *Angelica archangelica* has been carried out. The percentage yield of the oil is 0.4% and its constituents are: α -pinene (11.4%), camphene (1.9%), limonene (0.8%), α -phellandrene (0.6%), β -phellandrene (2.1%), *p*-cymene (1.4%), β -caryophyllene (2.4%), β -bisabolene (1.5%), hexyl methyl phthalate (36.0%), an unknown acid (1.6%), a mixture of coumarins (18.1%), bergaptene (19.6%) and oxypeucedanin (2.6%). The major oxygenated component of the oil namely hexyl methyl phthalate is a new find in the essential oil of the Pakistani *Angelica archangelica* seed.

INTRODUCTION

Angelica is a large genus having some 80 species which occur in the northern hemisphere. The heaviest concentration of the species of the genus is met with in Japan. So far twenty-three of the species including nine which are endemic have been reported to grow in this country. Sixteen of the species containing two that are endemic, occur in the USSR while eight species are distributed in Europe. Only two species and one variety namely *Angelica archangelica*, var. *Himalaica*, *Angelica glauca* and *Archangelica oreodum* have been reported to grow in Pakistan. The plants are perennial herbs. The *Archangelica* spp is sometimes kept separate from the species *Angelica* and sometimes included in them.

Angelica archangelica is native to Europe and the Eastern United States where it grows wild. The plant is also cultivated in Germany and France for its roots and seeds for the extraction of essential oil to be used in various food products. The roots and the seeds of the plant are also used in medicine for various ailments. Prolonged distillation of seeds and roots yields an oil of superior quality. This oil contains lactones which are the most important and characteristic constituents so far as odour and flavour are concerned.

The present investigations have been carried out to study the quality and chemistry of the essential oil obtained from the indigenous *Angelica archangelica* seeds.

MATERIALS AND METHODS

The seeds of *Angelica archangelica* were collected from

Naran in the Kaghan valley. The seeds were crushed and steam-distilled as usual [1]. The oil was recovered by extraction of the aqueous distillate with diethyl ether. The general methods used for the analysis of the essential oils have already been communicated [1, 2]. Besides these methods, a Beckman DB spectrophotometer was used to record the UV spectra of coumarins.

The essential oil was resolved into hydrocarbon fraction and oxygenated components by column chromatography using activated silica gel as an adsorbent. The hydrocarbon fraction of the oil was eluted with n-hexane and the oxygenated components with increasing proportions of diethyl ether (1-10%) in n-hexane. The lactones present in the oil were, however, eluted from the column with pure diethyl ether. Ten fractions were collected and those with identical behaviour by TLC and IR were mixed thus giving rise to four final fractions which were further resolved and their constituents identified by GLC and IR.

RESULTS

The percentage composition of the essential oil obtained from the seeds of *Angelica archangelica* is recorded in Table 1.

DISCUSSION

The hydrocarbon fraction of the essential oil of the *Angelica archangelica* when resolved by GLC gave six monoterpenes and two sesquiterpenes which were identi-

Table 1. Chemical composition of the essential oil of *Angelica archangelica* seeds.

Eluent	Component	Percentage
n-Hexane	Hydrocarbons *	22.1
	α-Pinene	11.4
	Camphene	1.9
	Limonene	0.8
	α-Phellandrene	0.6
	β-Phellandrene	2.1
	c-Cymene	1.4
	β-Caryophyllene	2.4
	β-Bisabolene	1.5
2% Diethyl ether in n-hexane	Hexyl methyl phthalate	36.0
10% "	An unknown acid	1.6
100% "	Mixture of coumarins	18.1
	Bergaptene	19.6
	Oxypeucedanin	2.6

*: Resolved and estimated by GLC.

fied by coinjecting with their standard samples.

Bakina and Senchenko [3] have analyzed the essential oil of the fruit of *Angelica archangelica* by GLC and reported α-pinene, β-pinene, myrcene, β-phellandrene, α-terpinene, p-cymene, β-bisabolene, β-elemene, γ-cadinene, humulene and α-bisabolol as the constituents of the oil. We have on the other hand, identified α-pinene, camphene, limonene α- and β-phellandrene, p-cymene, β-caryophyllene and β-bisabolene in the hydrocarbon fraction of the essential oil of the indigenous *Angelica archangelica*.

The major oxygenated component in the oil under discussion was found to be hexyl methyl phthalate. Identification of this compound depended on IR analysis followed by NMR results. However, some more chemical work is needed for the confirmation of this novel compound to be present in the essential oil of an Umbelliferae species.

Bakina and Senchenko [3] have reported α-bisabolol

in the essential oil of *Angelica archangelica*. We could not detect this sesquiterpenic alcohol in our oil. Instead an acid was extracted from the Pakistani species which is still to be identified. The presence of hydroxy myristic acid has also been reported by the earlier worker [3, 4] in the essential oil of *Angelica archangelica*.

The essential oil from the Pakistani species also contained a considerable amount of coumarins which contributed mainly to the characteristic smell of the oil. We were able to separate and identify only two coumarins, namely, bergaptene and oxypeucedanin. The presence of coumarins in the essential oil of *Angelica archangelica* has already been reported by the earlier workers [3, 4].

In the light of the present studies it can be concluded that the major oxygenated component of the oil is a new finding in the essential oil of the Pakistani *Angelica archangelica* seeds.

The commercial importance of the species can only be clear after studying the bacteriostatic/bacteriocidal activities of the oil. However, the medicinal values of the oil as reported earlier are quite promising.

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