

Chemical composition of the essential oil of bitter fennel (*Foeniculum vulgare* subsp. *piperitum*)

M Ozcan & A Akgul

Department of Food Engineering, Faculty of Agriculture
Selcuk University, 42031 Konya, Turkey.

Received 26 March 2001; Revised 17 October 2001; Accepted 13 November 2001.

Abstract

The composition of the essential oil obtained by steam distillation from seeds of bitter fennel (*Foeniculum vulgare* subsp. *piperitum*) was analysed by GC/MS. The presence of atleast seventeen compounds was demonstrated. They correspond to 99.95% of the oil. Methyl chavicol was the main constituent of the oil (47.09%), followed by limonene (29.07%), fenchone (13.43%), α -terpinene (2.5%), fenchyl acetate (exo) (1.95%) and *cis*- β -ocimene (1.41%). *Trans*-anethole was not detected. Therefore, it is concluded that the oil of Turkish bitter fennel is rich in methyl chavicol.

Key words: essential oils, fenchone, *Foeniculum vulgare* subsp. *piperitum*, limonene, methyl chavicol, Turkish bitter fennel.

Foeniculum vulgare subsp. *piperitum* is a perennial or annual herb and a typical aromatic plant of the Mediterranean. It is a member of the Umbelliferae family, growing to a height, ranging from 70-200 cm (Davis 1972). It grows wild in most regions, especially in west and south regions of Turkey. Fresh or dried herb and fruits of bitter fennel (called 'malotra' in Turkish) are used as a flavouring agent for some foods such as salad, cacik and soup.

Each variety, because of morphological characteristics, is known to possess a specific essential oil composition, with fenchone and (E)-anethole being the most important component. The amounts of these components may vary in the oils of different origin. Specific estragole chemotypes are also known to be present (Lawrence 1994; Bernath *et al.* 1996).

Though the composition of essential oil of *Foeniculum* species from different origins was

investigated, very little work was done in bitter fennel on this line (Dogan *et al.* 1984; Akgul & Bayrak 1988; Badoc *et al.* 1994; Bernath *et al.* 1996). This paper reports the results of an investigation into the oil obtained from the seeds of bitter fennel by hydrodistillation.

The fruits of bitter fennel, identified by the laboratory of Systematic Botany, University of Selcuk, Konya were collected from Mersin (Buyukeceli-Gulnar) in August 2000. Dried and ground seeds (about 200 g) were subjected to hydro-distillation for 3 h using a Clevenger apparatus. The oil used for GC and GC/MS analysis was dried over anhydrous Na₂SO₄ and stored in a refrigerator. The oil was analysed with a high resolution Hewlett-Packard G 1800B GCD gas chromatograph, equipped with a 30 m x 0.25 mm HP-5 fused silica capillary column (0.25 μ m film thickness). The injector temperature was 200°C and the EID was heated

Table 1. Chemical composition of oil of *Foeniculum vulgare* subsp. *piperitum*

RI	Compound	Percentage
932	α -pipene	1.22
947	Camphene	0.21
972	Sabinene	0.22
990	Myrcece	1.08
1006	aphellandrene	0.50
1024	<i>p</i> -cymene	0.44
1029	Limonene	29.07
1036	β -ocimene (Z)	1.41
1046	β -ocimene (E)	0.05
1058	α -terpinene	2.50
1089	Fenchone	13.43
1138	Limonene oxide (E)	0.06
1144	Camphor	0.25
1203	Methyl chavicol	47.09
1221	Genchyl acetate (endo)	0.25
1234	Fenchyl acetate (exo)	1.95
1484	Germacrene D	0.22

to 250°C. The column temperature was programmed from 70°C to 200°C at 4°C per min. The carrier gas was He at a flow rate of 1.0 ml per min. The Mass Spectra (MS) were taken at 70 eV and mass range was m/z 45/450. Sample was injected twice. Components were identified by comparing their retention indices and mass spectra with data in the literature (Adams 1989; McLofferty 1989).

The yield of the oil was about 2.9 per cent. Among the seventeen compounds, representing 99.95% of total oil, methyl chavicol (47.09%), limonene (29.07%) and fenchone (13.43%) were predominant (Table 1). The present studies have shown that the oil of bitter fennel contained mainly oxygenated monoterpenes. It was reported that the chemical composition of bitter fennel oils are very variable, the chemovarieties and the environmental conditions being the causative factors. Several workers reported the chemical composition of

fennel oils from different origin and the major components reported were methyl chavicol, *trans*-anethole, limonene, fenchone α -terpinene and piperitonene oxide (Marotti *et al.* 1994). Similar results were obtained by Dogan *et al.* (1984) and Menghini & Pocceschi (1996). This study clearly indicated that the oil of Turkish bitter fennel belonged to methyl chavicol rich type.

References

- Akgul A 1986 Studies on the essential oils from Turkish fennel seeds (*Foeniculum vulgare* M. var *dulce*). In: Brunke E-J & Walter de Gruyter (Eds) Progress in Essential Oil Research, (pp. 487-489). Berlin.
- Akgul A & Bayrak A 1988 Comparative volatile oil composition of various parts from Turkish bitter fennel (*Foeniculum vulgare* var *vulgare*). Food Chem. 30 : 319-323.
- Badoc A, Deffieux G, Lamarti A, Bourgeois G & Carde J P 1994. Essential oil of *Foeniculum vulgare* Mill. (Fennel) subsp. *piperitum* (Ucria) Cout. Fruit. J. Essential Oil Res. 6 : 333-336.
- Bernath J, Nemeth E, Katta A & Hethelyi E 1996 Morphological and chemical evaluation of fennel (*Foeniculum vulgare* Mill.) populations of different origin. J. Essent. Oil Res. 8 : 247-253.
- Davis P H 1972 Flora of Turkey and East Aegean Islands, Vol 4, (pp. 376-377). University Press, Edinburgh.
- Dogan A, Bayrak A & Akgul A 1984 Studies on the essential oils from bitter fennel (*Foeniculum vulgare* subsp. *piperitum*) seeds. Ankara Univ. Agric. Fac. J. 34 : 314-319.
- Lawrence B M 1994 Progress in essential oils. Perfum. Flav. 19 : 31-32.
- Marotti M, Piccaglia R, Giovanelli E, Deans S G & Eaglesham E 1994 Effects of variety and ontogenic stage on the essential oil composition and biological activity of fennel (*Foeniculum vulgare* Mill.) J. Essent. Oil Res. 6 : 57-62.
- McLofferty F W 1989 Registry of Mass Spectral Data. 5th Edition. John Wiley & Sons, New York.
- Menghini A & Pocceschi 1996 Comparison of the essential oil composition of seed fennel cultivated in central Italy. Atti. Convegno internazionale: Coltivazione e miglioramento di piante officinali, Trento, Italy, 2-3 giugno pp. 531-536.