THE PHARMACOGNOSY OF LOCAL *FOENICULUM VULGARE* (VARIETY *VULGARE*)

Tonio Pace

Introduction

The medicinal plant *Foeniculum vulgare* (Miller) subspecies *capillaceum* (Galib.) Holmboe variety *vulgare* known more commonly as (bitter) fennel is widely distributed all around the Maltese islands. The plant produces fruit in late summer and these fruits are considered to be an official crude drug by the B.P. and U.S.P. The purpose of this study was to evaluate the characteristics of the plant and its oil with regards to its botanical characteristics, its uses and its marketing around the world. The second part dealt with the physico-chemical properties of the oil distilled from the local plant collected from the wild as compared to that obtained from fennel grown abroad.

Fennel is an umbelliferous plant which is well adapted to grow in adverse conditions which mainly involve high temperatures and limited water supply. Two ways in which these problems are overcome are:

1. Its life cycle enables the plant to build up energy in the first year with minimal transpiration since the plant does not grow higher than 50cm. This energy is used in the following year for the formation of flowers and seeds which would be otherwise have to be provided by foliage formation with the inevitable increase in the transpiration (though the leaf structure is such that transpiration is minimal).

2. Fennel oil being volatile, in the hotter temperatures tends to evaporate absorbing the latent heat from the plant; thus preventing overheating of the plant.

Methodology and Results

Laboratory Investigations

Steam Distillation

Most of the studies carried out in the past (for example Clevenger, 1942) show that the volatile oil content obtained by steam distillation of fennel varies beween 1-4% v/w. However, occasionally, values up to 6% v/w have also been quoted (Fisher, Tornow and Proper, 1945). The United States Pharmacopoeia (1980), requires that the dried fruit of

fennel contain from 3 to 4% of volatile oil. Table 1 shows the highest percentage of volatile oil (v/w) obtained by steam distilling different parts of **local** fennel between July and December 1991.

Table 1: Highest Amounts of Volatile Oil obtained from Different Parts of the Fennel Local Plant

Part of Plant	% oil (v/w)	Time of Year
Flower	6.1	late July
Seed	4.4	late August
Leaf	2.4	late August - mid-September
Stalk	2.7	late July

Both in the flower and in the seed, fennel oil was present in a relatively high percentage especially in the flowers distilled in July 1991.

One possible reason is that since the Maltese climate is hot especially in the summer months in which the fennel plant flowers and produces seeds, the higher amount of volatile oil produced may be an advantage to overcome the problem of overheating. Since all the samples of the plant were collected from the same location (Gudja limits of Luqa) any difference in the types of soils.

The lowest results were recorded, as expected, in the leaf and in the stalks. This may be due to the fact that the stalks and leaves attribute little to long term storage of energy. These photosynthetic parts of the plants are more involved in the production and transport of energy in the form of carbohydrates rather than the storage of this energy.

Commercially speaking, this is in itself beneficial since weight to weight basis, local fennel yields higher amounts of fennel oil than most samples distilled in other countries.

Chemical Analysis of Fennel Oil

Different samples of fennel oil were submitted to Dr Alfred Vella at the Chemistry Department, University of Malta, who performed a combination of Gas Chromatography and Mass Spectrometry in order to

investigate its quality with respect to the contents of anethole and fenchone. Results of such studies all around the world (for example Betts, 1968; Karlsen et al., 1969) demonstrate that of all the chemical constituents of bitter fennel oil, anethole is the main one, the trans-isomer being more prevalent than the cis-isomer (Naves and Tucakov, 1959) - trans-anethole (50-80%), cis-anethole (>0.3%). Locally, the corresponding results were dissimilar since the cis-anethole was present in a relatively higher amount than the trans-isomer; this is true for the flower, seed and the leaf oil. At this point it should be noted that any of the uses described for fennel oil obtained in other countries (mainly carminative and flavouring uses) may not be the same when referring to local fennel oil owing to the variation in the main constituent.

Other experiments were performed on the local fennel plant and its oil to establish further the Pharmacognosy of local fennel. These included determination of the percentage moisture content, the protein, fibre, fixed oil, total ash and insoluble ash content.

Conclusion

Keeping all this in mind, any definite conclusions would be premature since the differences between local and foreign fennel described above could be due to several reasons. Some factors that however may have an effect on local fennel include the high summer temperatures and the quality of the soil in which fennel grows. It may be the case that there is something peculiar about the local plant itself e.g. a different enzyme (possibly in the shikimic acid pathway). This provides enough basis for further studies to be ensued on the lines of:

- establishing the factor(s) that effect the amount of volatile oil present in the plant and how can these be utilized in a positive way;

- considering cultivation as a means of utilising to the full local fennel;

- calculating the cost-effectiveness of the whole process of obtaining fennel oil;

- studying more deeply the reason(s) why cis-anethole is present in more abundance than the trans-isomer;

- analysing the possibility of utilising certain waste land areas for more production of fennel in the wild;

- investigating whether the high yield of fennel oil exists at the expense of the quality of fennel.

References

Clevenger, J.F. Determination of Volatile Oils in Spices. Assay of Caraway and Fennel Seeds. *J. Assocn. Official Agr Chem* (1942); 25:692.

Fisher, E., Tornow, M. and Proper, L. Investigations of the Essential Oils of the plant family *Umbelliferae. Bull. Natl. Form. Comm.*, 1945; 13: 6.

Karlsen, J. et al. Studies on the fruits of *Foeniculum* species and their essential oil. *Planta Med.* 1969; 17: 238-293.

Naves, Y.R. and Tucakov, J. Presence of anetholes in the essential oils of the fennel in Yugoslavia. *Compt. Rend.* 1959; 248: 843-854.

Remington's Pharmaceutical Sciences, 18th Edition (1990): 1294.

Toth, L. Anethole and fenchone in the developing fruits of *Foeniculum vulgare* Mill. *J. Pharm. Pharmac.* 1967; 20: 469-472.