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## FENNEL

**Family:** *Umbelleriferae*

**Genus:** *Foeniculum*

**Species:** *vulgare*



Source: <http://aggie-horticulture.tamu.edu/syllabi/325/lab/crop-3.jpg> <http://www.eps4.comlink.ne.jp/~andersen/image/herbs/fennel.jpg>

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## **General Background**

Other names/synonyms: Sweet Cumin; Dutch = venkel, French = Fenouil, Aneth doux, German = Fenchel, Italian = Finocchio, Portuguese = Funcho, Spanish = Hinojo, Swedish = Fänkål.

It is a stout, erect glaucous hardy perennial. Leaves are greatly divided with hair-like segments. Flowers are 1-2mm in diameter, yellow, in typical compound terminal umbels, and appear from July to September. Commercially it is grown as an annual or biennial. All parts of the plant are aromatic - leaves are used as a culinary herb, petioles are used for salad or as a vegetable, bulbs are also used as a vegetable. The seeds contain essential oil and fatty acids.

There are four forms of this species:

*Wild Fennel* - A large hairless plant with solid stems growing to 2m in height. Leaves are pinnate, the segments 1-5 cm long, thread-like, waxy, dark green. Flowers are 1-2 mm across and bright yellow. Fruits are 4 mm long, oblong-ovate, flattened, greenish or greyish.

*Sweet Fennel*. (*var. dulce*) - The form of this plant that is grown for seed has the same structure as Wild Fennel but the fruits are generally larger. It is easily distinguished from Wild Fennel by the aniseed scent of both leaves and fruits.

*Florence Fennel*. Also belongs to *var dulce*. It has shorter basal leaves which are greatly swollen at the bases, forming a sort of false bulb the size of a large apple.

*Carosella* (*Var. piperatum*) is a larger plant than wild or sweet fennel, with very long leaf sheaths which envelop the flowering stalks.

Fennel was originally of Mediterranean origin although now it grows wild in Europe and in most temperate countries and is naturalised in the western USA.

## **Details of Quality Characteristics**

### **Essential Oil**

The essential oil of the most important fennel variety (*var. dulce*) contains anethol (50-80%), limonene (5%), fenchone (5%), estragol (methyl-chavicol), safrol, alpha-pinene (0.5%),

alpha-phellandrine, camphene, beta-pinene, beta-myrcene and p-cymen. In contrast, the uncultivated form (var. vulgare) contains often more essential oil, but since it is characterized by the bitter fenchone (12 to 22%), it is of little value.

Steam distillation of wild fennel has been used to characterise five chemical groups in the essential oil. These are:

1. Alpha-phellandrene, methyl chavicol and trans-anethole
2. alpha-pinene, limonene and trans-anethole
3. methyl chavicol and alpha-phellandrene
4. methyl chavicol and alpha-pinene
5. alpha-phellandrene

(Piccaglia and Marotti 2001)

### **Seed Oil**

The seeds of fennel contain approximately 20% fatty oil, of which about 80% is petroselinic acid. Petroselinic acid (C 18:1) is a characteristic fatty acid of the family *Umbelliferae* and particularly of fennel oil. Levels as high as 70-80% have been recorded (Chariot *et al.* 1991). This acid is of interest because of its antimicrobial activity and because its oxidation gives Lauric acid (C12:0), a very important fatty acid used in the soap, cosmetic, medical and perfume industries, and Adipic acid (C6:0). Petroselinic acid and oleic acid are always combined in umbelliferous oils. Extraction of the essential oil is by steam distillation. Sweet fennel oil from crushed seeds, and Bitter fennel oil from crushed seeds or the whole plant.

Sweet Fennel also contains the essential oil anethol. Fennel is also rich in limonene and contains 200-9420ppm in the seed (Duke, duCellier 1993). Principal constituents of fennel oil are: Anethol (50-60%), limonene, phallandrene, pinene, ansic acid, anisic aldehyde, camphene, limonene. Bitter fennel oil contains 18-22% fenchone; sweet fennel oil contains little or none.

### **Flavonoids**

The following compounds have been identified and crystallised from fennel: Quercetin 3-glucuronide, isoquercitrin, rutin, quercetin 3-arabinoside, and isorhamnetin glucoside. Other

compounds which have been identified though not crystallised are: kaempferol 3-glucuronide and kaempferol 3-arabinoside (Kunzemann and Herrmann 1977).

### **Current Production and Yields**

Fennel is grown on a commercial scale in Austria, Finland, France and Germany for the production of speciality products. Belgium has expressed scientific interest in the production of fennel for speciality products although pilot trials are not yet underway. In 1995 the planted area in France for medicinal, aromatic and perfume plants was between 10 to 100 ha for sweet fennel and between 100 to 1000 ha of bitter fennel. The area of fennel cultivated on set-aside areas in Germany was 4 ha in 1997 and 2 ha in 1998 from a total area of set aside land of 111ha and 148 ha respectively. An informal estimate of world markets for 2000 and oil yields for fennel is 260 tonnes of which the available oil yield is 87 kg/ha (IENICA, 2000).

As a food crop wild Fennel is the form mainly cultivated in central and eastern Europe, while Sweet Fennel is grown on a large scale in France, Italy, Greece and Turkey. Much of the seed of European commerce comes from India, which exports up to 2000 tonnes annually. The development of Sweet Fennel and of the vegetable forms is due entirely to the Italians. Florence Fennel, which requires careful husbandry, is now produced by market-gardeners in France, Holland etc., but the bulk of the crop comes from Italy. Approximately 17,000ha of fennel is cultivated in Italy, which produces around 370,000 tonnes. 25,000 tonnes of this is exported each year, mainly to France and Switzerland. 30% of national production is in the Apulia region. Most of the fennel in Italy is produced from local seeds such as Naples Extra Large and Sicilian Round. In 1997 15,989kg of fennel was imported into the USA from Spain.

### **Constraints upon Production**

Fennel can survive in the temperature range of 4 to 27 degrees centigrade and a soil pH of 4.8 to 8.3. It thrives on a well-drained loam.

Florence Fennel is cultivated mostly in southern Europe, and tends to bolt when attempts are made to grow it in cooler climates. Fennel contains a high proportion of petroselenic acid, however the plant has a long life cycle and so currently coriander is the species most likely to be developed should the need arise.

## **Markets and Market Potential**

Parts used are leaves, stems, roots, seeds and oil. A sweet, aromatic, herb that relieves digestive problems, increases milk flow, relaxes spasms and reduces inflammation. Fennel has also been reputed to promote menstruation, facilitate birth and increase libido.

The active ingredient was thought to be anethole, however, further research suggests that the active ingredients are polymers of anethole (Albert-Puleo 1980). Fennel has been shown to have antioxidant and antibacterial activities (Ruberto et al 2000). The oil from fennel is used in the perfume industry.

*Culinary* - Leaves and seeds can be used as flavouring for food.

*Aromatic* - Oil is used in perfumes.

*Medical*- Fennel acts on smooth muscle and can be used internally for indigestion, wind, colic, bronchitis and coughs. Externally as a mouthwash or gargle for gum disease and sore throat. Experimentally it has been shown to increase liver regeneration. The volatile oil is bactericidal and anti-fungal and has been shown to be effective against *Staphylococcus aureus* and *Candida albicans*.

*Economic* - Oil is used in food flavourings, toothpastes, soaps and air-fresheners.

The antiviral activity of the essential oils of *Feniculum vulgare* has been tested against PVX (potato virus X), TMV (tobacco mosaic virus) and TRSV (tobacco ring spot virus). The essential oil totally inhibited the formation of local lesions at a concentration of 3000 ppm (Shakla et al 1988).

## **Other Information**

### **Research**

Further research by Albert-Puleo suggests that the actual pharmacologically active agents are polymers of anethole, such as dianethole and photoanethole.

### **Useful Websites**

<http://www.nf-2000.org/secure/Crops/F581.htm>

[http://www-ang.kfunigraz.ac.at/~katzer/engl/generic\\_frame.html?Foen\\_vul.html](http://www-ang.kfunigraz.ac.at/~katzer/engl/generic_frame.html?Foen_vul.html)

## **BioMat Net**

[Coriander \(\*Coriandrum sativum\*\)](#) (related plant)

## **Contacts**

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