Fennel

**BOTANY**

*Foeniculum vulgare* Mill., known as fennel, belongs to the *Foeniculum* genus in the Apiaceae family.

It is an herbaceous, perennial plant, erect, intense green colored, extremely aromatic that can reach a height of 2 meters. The leaves are long and thin, like a nail at the end, that harden during winter to avoid water loss. The flowers appear during summer (till autumn) in groups of 20 to 50 small yellow-green colored flowers with a typical anise smell.

This species is found in temperate areas all over the world, though it is native of southern Europe, especially in the Mediterranean coast, where it grows spontaneously. It can be found naturally in fields, roads and abandoned dry meadows.

Fennel is an extract obtained from the fruit of *Foeniculum vulgare* Mill.
CHEMISTRY

The chemical composition of fennel fruits is (Alonso, 2004; Krizman, 2007; Gurinder, 2009):

- Flavonoids (approx. 15%): kaempferol, quercetol, rutoside and quercitroside.
- Phenolic compounds: caffeoylquinic acid and dicaffeoylquinic acid, chlorogenic acid, eriocitrin, rutin, miquelianin and rosmarinic acid.
- Alkaloids (approx 3%)
- Tannins (approx 28%)
- Saponins (approx 0.6%)
- Mineral salts and vitamins.
- Essential oil (2-6%): containing anethole, estragol, pinenes, limonene, myrcene, d-fenchone, camphene, sabinene, α- and β-phellandrene, γ-terpinene, fenchol, anisaldehyde and 1,8-cineole.

TRADITIONAL USES

Fennel has properties as analgesic, laxative, anti-inflammatory, antispasmodic, aromatic, stimulating, emmenagogue, purifying, expectorant, galactogogue, diuretic, carminative and to relieve difficult digestions and colitis. For indigestions it is used as an infusion, and also for abdomen distension and stomach pain. In combination with bearberry (*Arctostaphylos uva-ursi*), it is used against cystitis and to clean the eyes and treat conjunctivitis. In ancient times it was used as a collyrium.

Today, the herbalists recommend an infusion of crushed fennel fruits to clean the eyes, and they consider it a good remedy for stomach pain, gastrointestinal colics and flatulence. The pharmacologists also recommend it as an antispasmodic.

It has also been used in cooking during more than 2,000 years, its tasty stem, seeds and leaves. It is frequently used in the Mediterranean food. The leaves, cooked or raw, smell of anise, especially the youngest, and are used as additives in salads because they help in oily food digestion. Fennel fruits are widely used for producing spirits, gins or as preservatives. From the fennel a yellow colorant can be obtained.

In addition to its culinary properties, fennel is thought to have the power to chase bad spirits and its water was considered aphrodisiac by the Arabic culture.
COSMETIC PROPERTIES

Antioxidant activity

A bioguided isolation of an aqueous extract of fennel led to the isolation of 12 major phenolic compounds. Radical scavenging activity was tested using three methods: DPPH•, superoxide nitro-blue tetrazolium hypoxanthine/xanthine oxidase, and •OH/luminol chemiluminescence. The isolated compounds exhibited a strong antiradical scavenging activity, which may contribute to the interpretation of the pharmacological effects of fennel (Parejo, 2004).

In a study conducted by Faudale et al. in 2008, the antioxidant activity and the total phenolic and flavonoid content, as well as the quantitative determination of individual flavonoids and phenolic acids of wild, edible, and medicinal fennel from different Mediterranean countries, was determined. The antioxidant activity was measured as the free radical (DPPH), hydroxyl radical, and superoxide anion scavenging activities. Wild fennel was found to exhibit a radical scavenging activity, as well as a total phenolic and total flavonoid content, higher than those of both medicinal and edible fennels (Faudale, 2008).

The antioxidant activity of the aqueous extracts of five umbelliferous fruits, including fennel, were investigated in comparison with the known antioxidant ascorbic acid in in vitro studies. The present study revealed strong antioxidant activity of their extracts that was superior to known antioxidant ascorbic acid (Satyanarayana, 2004).

Thus, fennel extract is well recommended when formulating cosmetic products for protecting the skin and hair from oxidative processes.

Anti-inflammatory activity

Flavonoids are responsible for this activity, synergized by plant sterols (β-sitosterol and stigmasterol). This activity is observed after applying an ethanolic extract made from fennel dried fruit that not only reduces the induced edema, but also, when it is externally applied, it shows a clear anti-inflammatory action as well as healing activity (Alonso, J., 2004).

As anti-inflammatory actives, the flavonoids are capable of reducing the permeability of the capillaries and reinforcing their strength.
Furthermore, these actives may intervene in any of the stages of the inflammatory process. This is the case when they act on the metabolism of arachidonic acid. The flavonoids inhibit the enzyme 5-lipoxygenase and to a lesser extent the enzyme cyclooxygenase. It has been shown that the flavonoids are capable of reducing the infiltration of leucocytes that takes place during the inflammatory process and maintaining this effect for over 18 hours after their application. At the same time, they inhibit the release of the mediators of inflammation stored in the mastocytes. It has also been shown that these substances are antagonists of mediators of inflammation (histamine, bradicinine,...) and inhibit the lisosomal enzymes.

In a study conducted by Mascolo in 1987, an oral pre-treatment with a dry 80%-ethanolic extract from sweet fennel at 100 mg/kg body weight in rats inhibited carrageenan-induced paw edema by 36% (p<0.01) compared to 45% inhibition by indomethacin at 5 mg/kg.

In 2004, Choi tried an oral administration (200 mg/kg) of *Foeniculum vulgare* fruit methanolic extract, which exhibited inhibitory effects against acute and subacute inflammatory diseases and type IV allergic reactions and showed a central analgesic effect. Moreover, it significantly increased the plasma superoxide dismutase (SOD) and catalase activities and the high density lipoprotein-cholesterol level. On the contrary, the malondialdehyde (MDA) (as a measure of lipid peroxidation) level was significantly decreased in the *F. vulgare* extract group compared to the control group (p<0.05). These results seem to support the use of *F. vulgare* fruit in relieving inflammation (Choi, 2004).

Thus, fennel extract is of great use to formulate cosmetic products with anti-irritant activity.

**Antimicrobial activity**

In a study conducted by Gurinder in 2009, three medicinal plants viz. *Anethum graveolens* Linn. (Dill), *Foeniculum vulgare* Mill. (Fennel) and *Trachyspermum ammi* L. (Omum) belonging to the Apiaceae family were selected to assess their antibacterial potential.

Antibacterial activity of aqueous extracts was assessed using agar diffusion assay, minimum inhibitory concentration and viable cell count studies; the isolated phytoconstituents were subjected to disc diffusion assay to ascertain their antibacterial effect.
The results were encouraging as all the tested plants showed antibacterial potential, although the inhibitory activity was strain specific. The aqueous extracts of different plant seeds resulted in variable zone of inhibition (11–25 mm) for all the bacteria tested except *K. pneumonia* and *P. aeruginosa*, which were completely resistant. Hot water extracts of all the seeds were effective against *E. faecalis*, *S. aureus*, *E. coli*, *P. aeruginosa*, *S. typhimurium* and *S. flexneri*; while *S. typhi* was sensitive only to aqueous extracts of *F. vulgare* (12 mm).

Isolated groups of compounds demonstrated their antibacterial effect though to a lesser extent:

<table>
<thead>
<tr>
<th>Bacteria zone of inhibition in mm</th>
<th>Staphylococcus aureus</th>
<th>Pseudomonas aeruginosa</th>
<th>Salmonella typhimurium</th>
<th>Salmonella flexneri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloids</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.0</td>
</tr>
<tr>
<td>Flavonoids</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tannins</td>
<td>-</td>
<td>6.0</td>
<td>5.0</td>
<td>6.75</td>
</tr>
<tr>
<td>Saponins</td>
<td>10</td>
<td>-</td>
<td>5.0</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Therefore, fennel extract is recommendable to formulate cosmetic products with purifying and antiseptic activities.

**Astringent activity**

This activity is due to the tannin content of this plant. The astringent action of tannins is due to their capacity to form complexes with different substances.

Applied topically, tannins coat the outermost layers of skin and mucosa, thus protecting the deeper layers. These compounds also act as vasoconstrictor agents on superficial micro-vessels. By restricting fluid loss and preventing environmental damage, tannins promote tissue regeneration (epithelizing) in superficial wounds or burns (Bruneton J., 2001).

Therefore, fennel extract is recommendable to formulate cosmetic products with regulatory activity on sebum secretions and epithelizing action.
COSMETIC APPLICATIONS

<table>
<thead>
<tr>
<th>Action</th>
<th>Active</th>
<th>Cosmetic application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antioxidant</td>
<td>Phenolic compounds</td>
<td>Anti-aging</td>
</tr>
<tr>
<td></td>
<td>Flavonoids</td>
<td>Photo-protection</td>
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<td></td>
<td></td>
<td>Hair color protection</td>
</tr>
<tr>
<td>Anti-inflammatory</td>
<td>Flavonoids</td>
<td>Anti-irritant</td>
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<tr>
<td></td>
<td>Phytosterols</td>
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<td>Antimicrobial</td>
<td>Alkaloids</td>
<td>Purifying</td>
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<tr>
<td></td>
<td>Saponins</td>
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<tr>
<td>Astringent</td>
<td>Tannins</td>
<td>Sebum secretion regulation</td>
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<tr>
<td></td>
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<td>Epithelizing</td>
</tr>
</tbody>
</table>

RECOMMENDED DOSAGE

Recommended dosage is between 0.5% and 5%.

BIBLIOGRAPHY


