Sunflower Oil

**BOTANY**

*Helianthus annuus* L. Common name, sunflower. This annual plant is a member of the Asteraceae family. It is an erect, unbranched plant, growing up to 0.6-3m. The stem is semi-woody, solid, covered by a scarbid garment. Leaves are alternate, large, three-nerved, acuminate, toothed, with rough hairs on the upper- and the lower-surfaces and long petioles; their color varies from dark-green to yellowish-green, depending on the cultivation conditions and the variety. A plant usually bears 12-40 leaves. Flowers are clustered in solitary capitula, which have the ability to rotate. The capitula are large, flamboyant, 10-30cm in diameter. Floral receptacle is flat of semi-flat. Each capitulum includes two types of flowers: the inner and the outer flowers. The inner flowers are tubular, brown and hermaphrodite; these flowers produce the fruits. The outer flowers are ligulate, yellow and sterile; these flowers attract pollinator insects. Flowering occurs from July to September. The fruit, commonly known as sunflower seed, is an achene 3-20mm long and 2-13mm Wide. The pericarp is fibrous, hard, closely attached to the seed. At present, only a few countries cultivate substantial amounts of sunflower: the whole of the European Union, Central and Eastern Europe, the United States and Argentina. Smaller amounts are also cultivated in China, Turkey, India and South Africa.

Sunflower oil is produced by extraction and subsequent refining *Helianthus annuus* L. seeds.

**CHEMISTRY**

Sunflower seeds contain a high oil percentage, which ranges from 27 to 37% and even reaches 45%.

**Unsaturated fatty acids**

Sunflower seeds are rich in unsaturated fatty acids.

Table 1 shows the main fatty acids in sunflower seeds and their average proportions.

<table>
<thead>
<tr>
<th>Content</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmitic acid (C16:0)</td>
<td>6.07</td>
</tr>
<tr>
<td>Stearic acid (C18:0)</td>
<td>3.57</td>
</tr>
<tr>
<td>Oleic acid (C18:1)</td>
<td>28.7</td>
</tr>
<tr>
<td>Linoleic acid (C18:2)</td>
<td>60.0</td>
</tr>
<tr>
<td>Linolenic acid (C18:3)</td>
<td>0.22</td>
</tr>
<tr>
<td>Arachidic acid (C20:0)</td>
<td>0.25</td>
</tr>
<tr>
<td>Behenic acid (C22:0)</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Table 1. Unsaturated fatty acid content in sunflower oil.

1 Analyzed 05th August 2005. Nº ref. lab 06224.
Unsaponifiable
Sunflower oil also has a high proportion of sterols and tocopherol (vitamin E).

Table 2 shows the main sterols in sunflower oil and their percent proportions.

<table>
<thead>
<tr>
<th>Sterols</th>
<th>Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>β-sitosterol</td>
<td>60</td>
</tr>
<tr>
<td>δ-7-stigmasterol</td>
<td>7-14</td>
</tr>
<tr>
<td>δ-5-avenasterol</td>
<td>4-6</td>
</tr>
</tbody>
</table>

Table 2. Sterols content in sunflower oil (www.fitoterapia.net).

Sunflower also contains an important amount of α-tocopherol; 100gr sunflower oil contains an average of 55 mg α-tocopherol (www.fao.org/DOCREP/004/Y2809E/y2809e0f.htm).

Other active principles
Phenol acids (chlorogenic, caffeic), carotenoids, lecithin and minerals (mainly selenium, zinc, copper and iron).

TRADITIONAL USES

*Helianthus* comes from the Greek words *helios*, meaning sun and *anthos*, meaning flower. The word *annus* comes from the Latin word for annual.

The origins of sunflower date back to 3000 B.C. North of Mexico and West of the United States. Indian tribes in New Mexico and Arizona used to cultivate this plant. Sunflower was one of the major agricultural products consumed as a food in a number of American communities before the discovery of America. Spanish colonizers carried sunflower seeds to Spain, wherefrom it spread to the rest of Europe. For about two centuries, sunflower was cultivated as an ornamental plant in Spain and the rest of Europe, because of its beautiful inflorescences. The use of sunflower oil in the food industry started during the XIX century. At present, there is a long list of applications of sunflower seed-derived products. Row and refined oils, as well as flour, derived from sunflower are being increasingly used in the food industry and in novel cosmetic applications.

COSMETIC PROPERTIES

Skin barrier repairing activity
Sunflower oil is rich in essential fatty acids, which have important regulatory actions on skin elasticity and moisture (Coello Oliviella T., 1989).

Fatty acids deficiency produces skin lesions and deterioration, which result in desquamation, dry skin and reduced skin flexibility and smoothness. Keratinization becomes disorganized, mitosis and DNA synthesis decrease, the skin loses most of its protective functions and perspiration increases. Fatty acids deficiency-related lesions improve after percutaneous applications of fatty acids-rich oils. Therefore, such oils are extensively used in dermatology and cosmetics to treat dry skin and wrinkles, and to improve wound healing, through their tissue stimulating and regenerating actions (Holguera, M.C., 1993).

Vegetable oils and fats are good emollients, due to their lipophilic nature. These compounds efficiently prevent transepidermal water loss, because of their excellent occlusive properties. A number of studies have demonstrated that the higher the saturation degree of a certain oil, the lower its viscosity and the better its skin penetration (Le Poole, H.A.C., 1995).
In recent decades, much research has been conducted on the role of essential fatty acids in the formation and the barrier function of superficial skin layers. Some studies revealed that by applying linoleic acid (LA) and γ-linoleic acid (GLA) for some days, transepidermal water loss (TEWL) is reduced. After different treatments with LA or GLA, constant TWEL was observed for several days. However, the effects of applying other fatty acids reverted immediately. It was concluded that the action of LA and GLA on TEWL was not only due to their occlusive effects, but also to their ability to induce structural changes in the epidermis, particularly in the horny layer (Le Poole, H.A.C., 1995).

Emollients are mainly lipids and oils, which give the skin improved moisture, smoothness and flexibility. These compounds repair the skin and influence skin permeability, improving the barrier function. Stearic, linoleic, oleic, linolenic and lauric acids are emollient compounds habitually used in cosmetics and dermopharmacy (Kraft, JN & Lynde CW, 2005).

Vitamin E also has moisturizing activity, because it helps retain water in the skin. Repeated topical applications of vitamin E on the skin significantly reduce wrinkles and skin roughness (Le Poole, H.A.C., 1995).

Phytosterols are known to be good emulsifiers. Because of this property, these compounds are assumed to facilitate oil penetration into the skin, thus helping improve the skin (Le Poole, H.A.C., 1995).

Because of these reasons, sunflower oil is highly recommendable to formulate cosmetic products with moisturizing and emollient activities.

**Antioxidant activity**

Tocopherols are very efficient antioxidant agents. These active principles protect oils, cell membrane lipids and cell organelles from oxidation; α-tocopherol (vitamin E) has the strongest biological activity in the organism with very important actions in the skin (Le Poole, H.A.C., 1995).

It has been observed that topical applications of vitamin E result in a high absorption degree. Large amounts of topically applied vitamin E have been found in the horny layer as well as in deeper viable skin layers. This vitamin is also directly absorbed into the hair cortex (Idson B., 1993).

The antioxidant activity of vitamin E is due to its actual antioxidant action and to its free radical scavenger action

- **Antioxidant activity:** Reduces the formation of lipoperoxides in the skin. The cell membrane is rich in highly unsaturated phospholipids. The oxidation of these phospholipids, due to endogenous as well as exogenous factors, produces lipoperoxides which destabilize the cell membrane and produce skin ageing.

- **Free radical scavenger activity:** Protects the cells against free radicals, released by the lipoperoxides and involved in skin ageing.

Thus, sunflower oil is highly recommendable to formulate cosmetic products to protect the integrity of skin (anti-aging products) and hair (color protection products).
Photo-protective activity
Sutton, JD. (1983) carried out studies to verify the photo-protective action of sunflower oil. The mentioned researcher observed that sunflower oil absorbed UV radiation at 300-360 nm.

UV radiation induces the production of free radicals in the skin. α-tocopherol is a powerful scavenger, especially useful to stop free radical-triggered chain reactions in plasmatic membranes. Such reactions yield tocopheroxyl, a stabilized low-energy radical, which cannot initiate new chain reactions but may be regenerated by reducing antioxidants, such as vitamin E, or completely oxidized to stable end products (Idson B., 1993).

The superoxide dismutase enzyme (SOD) inactivates superoxide radicals in humans. This reactive oxygen species is generated in the skin under UV radiation. A study carried out on Guinea pigs revealed that irradiating the skin with UVA and UVB partially inactivated the SOD enzyme. However, the authors found that in skin areas pre-treated with α-tocopherol acetate, the SOD enzyme was better protected against UVA and UVB radiation (Idson B., 1993).

Thus, sunflower oil is recommendable to formulate cosmetic products with photo-protective activity.

Anti-hair loss activity
Essential fatty acids also have an effect on hair metabolism. Essential fatty acid deficiency brings about skin conditions such as scalp dermatitis, alopecia and hair depigmentation. These symptoms may be reverted by topical applications of linoleic acid-rich oils. Skolnik, P. et al (1977) carried out a study on a 19-year-old male maintained on a 4 months regimen of fat-free, intravenous hyperalimentation fluids. During the treatment period, an essential fatty acid deficiency developed in this patient. This deficiency, as well as all associated skin symptoms, reverted after a 21-day treatment consisting in topical applications of linoleic acid-rich oil.

Vitamin E plays a critical role in hair loss prevention because it stimulates scalp micro-circulation and recovers dystrophic cells in the hair bulbs. Vitamin E stimulates micro-circulation because it helps restore the movements of veins and arteries, thus promoting decongestion (Idson, B., 1990).

Because of these reasons, sunflower oil is useful to formulate cosmetic products to treat hair loss.

Hair conditioning activity
Consistent evidences indicate that vitamin E may be important to protect both hair and scalp from excessive heat and dryness, hair breakage from brushing and chemical treatments.

It has been demonstrated that vitamin E is directly absorbed by the hair cortex. Studies were carried out, in which healthy and damaged hair were repeatedly treated (more than 5 cycles) with a shampoo and a conditioner containing 1% vitamin E acetate. The deposition of vitamin E acetate on the hair and its degree of penetration were evaluated. The results revealed that deposition was accumulative. Additionally, better deposition was observed on damaged hair than on healthy hair.

Finally, vitamin E acetate showed better deposition on hair when it was formulated as a component of a hair conditioner rather than as a component of a shampoo (Idson B., 1993).

Thus, sunflower oil is recommendable to formulate cosmetic products with hair conditioning activity.
Antimicrobial activity
Dilika F. et al. (2000) carried out studies, which revealed that linoleic acid inhibited the growth of the following Gram-positive bacteria: *Bacillus cereus*, *B. pumilus*, *B. subtilis*, *Micrococcus kristinae*, and *Staphylococcus aureus*. The minimum inhibitory concentration (MIC) was between 0.01 and 1.0 mg/ml. Oleic acid acted against the bacteria: *M. kristinae*, *S. aureus* and *Enterobacter cloacae* with a MIC of 1.0 mg/ml. A synergistic effect of both acids against *S. aureus* and *M. kristinae* was observed.

Rodrigues, KL. et al. (2004) conducted a study to evaluate the antimicrobial activity of the ozonised sunflower oil Bioperoxoil® against some pathological strains *in vitro* and against *Staphylococcus aureus in vivo*. Bioperoxoil® was tested against *S. aureus*, *Pseudomonas aeruginosa*, *Candida albicans*, *S. typhimurium* and *Escherichia coli* using the agar diffusion method. *In vivo* experiments were carried out with Wistar rats through topical application of 3.5 mg/ml of the ozonised oil for 7 days after inoculation with *S. aureus*. Bioperoxoil® showed antimicrobial effects against all strains tested, with MIC values ranging from 2.0 to 3.5mg/ml. Bioperoxoil® also demonstrated protective effects on skin connective tissue and stimulating effects on wound healing, as compared to a neomycin-clostebol complex used as a positive control. The results indicated significant antimicrobial, anti-inflammatory and wound-healing activities for Bioperoxoil® as compared to other commercially available antimicrobial agents.

As commented above, sunflower oil has stimulating actions on the skin barrier function. This action is very useful to protect the skin from bacterial infections. Darmstadt, G.L. et al. (2004) tested the effectiveness of topical application of sunflower oil 3 times daily, to prevent infection in preterm infants. This treatment resulted in a significant improvement in skin condition and a highly significant reduction in the incidence of nosocomial infections compared with infants not receiving topical prophylaxis.

Thus, sunflower oil is highly recommendable to formulate cosmetic products with purifying and antiseptic activity.

COSMETIC APPLICATIONS

<table>
<thead>
<tr>
<th>Action</th>
<th>Active</th>
<th>Cosmetic Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restoring skin barrier function</td>
<td>Fatty acids, Vitamin E, Sterols</td>
<td>Skin conditioning</td>
</tr>
<tr>
<td>Antioxidant</td>
<td>Vitamin E</td>
<td>Anti-aging, Photo-protection, Hair color protection</td>
</tr>
<tr>
<td>Anti-hair loss</td>
<td>Fatty acids, Vitamin E</td>
<td>Anti-hair loss</td>
</tr>
<tr>
<td>Hair conditioning</td>
<td>Vitamin E</td>
<td>Hair conditioning</td>
</tr>
<tr>
<td>Anti-microbial</td>
<td>Fatty acids</td>
<td>Purifying, Antiseptic</td>
</tr>
</tbody>
</table>

RECOMMENDED DOSE

The recommended dose is between 0.5% and 5.0%.
BIBLIOGRAPHY


Holguera, M.C. Los aceites vegetales. NCP documenta, 1993; 192: 15-18 (ref. 645).


Kraft JN & Lynde CW. Moisturizers: What They are and a Practical Approach to Product Selection. Skin Therapy Letter, 2005; 10 (5): 1-8


Web sites: