Onion

**BOTANY**

*Allium cepa* L. Common name onion. This plant is either biannual or perennial (depending on the cultivation conditions). It is a member of the Liliaceae family.

The semi-cylindrical leaves emerge from a subterranean bulb, which bears fascicled, short, scarcely branched roots. The erect stem grows 100-200 cm tall, habitually during the second year of the plant’s life. An umbel-like inflorescence composed of white or greenish-white small flowers, grows at the tip of the stem. The fruits are capsules, which contain black flat seeds. The edible bulb can grow up to 10 cm in diameter; it is composed of several overlapping layers on a central core.

There are about 450 species in the genus *Allium*, almost all of them native to the northern hemisphere. Although native to Asia – probably to the southwest of India, Afghanistan, Iran and the Turkistan area – onion has spread worldwide. It is rarely found in the wild. This plant needs deep, mineral-rich soils. The main producer countries are: China, India, the United States, Japan, the former URSS and Spain.

Onion extract is produced from the bulbs of *Allium cepa*. 
CHEMISTRY

Sulfur-containing compounds

Volatile sulfur-containing compounds are characteristic of *Allium*. These compounds do not occur naturally in onion; when onion cells are damaged, the alliinase enzyme reacts to transform volatile precursors [S-alk(ene)yl-cysteine-sulfoxides] into different thiosulfonates and other compounds related to the sulfonic acid. Degradation of thiosulfonates such as allicin occurs through a number of metabolic reactions. Thiosulfonates are transformed through degradation pathways other than enzymatic, into sulfur-containing compounds such as cepaenes, mono-, di-, tri- and tetra-sulfur compounds, thiols, thiophenes and sulfur dioxide.

Essential oil

This essential oil mainly consists of sulfur-containing compounds of the di-sulfur type, the most important one being dipropyl-disulfur and, to a lesser degree, methylpropyl-dimethylthiophene, methyl-cis-propenyl-disulfur, allicin, etc.

Flavonoids

Onion is one of the most important sources of dietary flavonoids. Flavonoids in onion include seven quercetin glycosides: (4'-glycoside, 7,4'-diglycoside, 3,4'-diglycoside, 3-glycoside, 7-glycoside, 3-rutinoside or rutin, and 3-rhamnoside or quercetin), 7,4'- and 3-kamepferol glycosides, isorhamnetin 4'-glycoside and 8 anthocyanins.

Table 1 shows the flavonoid content of raw onion (USDA, 2003).

<table>
<thead>
<tr>
<th>Product</th>
<th>Sub-classes</th>
<th>Compounds</th>
<th>mg/100g edible portion</th>
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<tbody>
<tr>
<td>Raw onion</td>
<td>Flavonols</td>
<td>Isorhamnetin</td>
<td>1.91</td>
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<td>Kaempferol</td>
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<td>Quercetin</td>
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<td>Cyanidin</td>
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<tr>
<td>Raw chive</td>
<td>Flavonols</td>
<td>Kaempferol</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Quercetin</td>
<td>14.24</td>
</tr>
</tbody>
</table>

Table 1. Flavonol content in onion (Muñoz Navarro B et al, 2005).
Other active principles

Oligofructans (35-40% dry weight), prostaglandins (a1, a2, b1, e1, f1α, f2α, d2, e2, and 6-keto-prostaglandins f1α), sterols, steroidal saponins, oligofructan and vitamins C1, B1, D and E.

Fig.1. Molecular structure of major onion components (Griffiths G. et al., 2002).

TRADITIONAL USES

Available data indicate that the genus name *Allium* comes from the Celtic word *all-*pungent. Onion has been used as a food and medicine since very ancient times. This vegetable has been mentioned in writings from the times of the Sumerians, Chaldeans, Egyptians, Chinese and Greeks. Dioscorides claimed that onion promoted the growth of ringworm-affected hair.

Applications of the bulbs macerated in water, or of onion juice, are popularly used for their antibiotic, diuretic, expectorant, hypoglycemic, prostate-relief and antispasmodic properties. In India, it is also used as an aphrodisiac. Local applications of onion juice or anion slices are used to treat acne, insect bites, boils, chilblains, for wound healing and for hair growth stimulation.
COSMETIC PROPERTIES

Antimicrobial activity

The water extract prepared with Allium cepa bulb’s juice inhibited the growth of Escherichia coli, Serratia marcescens, Streptococcus sp., Lactobacillus odontolyticus, Pseudomonas aeruginosa and Salmonella typhosa, in vitro. The ether-petroleum extract of the bulb inhibited the growth of Clostridium paraputrificum and Staphylococcus aureus, in vitro. The essential oil was effective against a variety of fungi including: Aspergillus niger, Cladosporium werneckii, Candida albicans, Fusarium oxysporium, Saccharomyces cerevisiae, Geotichum candidum, Brettanomyces anomalus and Candida lipolytica (Who monographs, 1999).

Furthermore, fresh onion juice has demonstrated bacteriostatic properties on staphylococci and streptococci. Different onion extracts have shown inhibitory effects on Streptococcus mutans and Porphyromonas gingivalis cultures. Onion juice – much like garlic juice – is toxic to Biomphalaria alexandrina, an intermediary host of Schistosoma mansoni (Alonso J, 2004).

Saleheen D. et al (2004) evaluated the anti-leishmanial (Leishmania sp) effect of aqueous onion extract (AOE). Five leishmanial strains in the promastigote stage were studied in vitro. Seventy-two hour inoculation of AOE to the promasigotes gave IC100 and average IC50 values of 1.25 mg/ml and 0.376 mg/ml, respectively, against all leishmania strains tested. These results evidenced the capacity of onion juice to fight Leishmania.

The anti-microbial activity of onion extract is mainly due to its sulfur-containing compounds. Its proteins, saponins and phenol compounds are also involved in the anti-microbial action (Griffiths G., 2002).

Therefore, onion extract is highly recommendable to formulate cosmetic products with purifying and antiseptic activity.

Antioxidant activity

The plants included in the Allium genus have antioxidant properties. Onion has been found to reduce cardiovascular illnesses by slowing-down the evolution of atherosclerosis and thrombosis. Such an outcome has been attributed to the antioxidant, xanthin oxidase inhibitory, and superoxide radical scavenging activities of onion peel. Some epidemiological studies relate onion’s antioxidant activity to the presence of organosulfur-compounds and flavonoids (Muñoz Navarro B et al, 2005).

Most flavonoids in Allium are powerful antioxidants with very diverse biochemical functions involved in the immune function, enzymatic activities, platelet aggregation and metabolism of collagen, phospholipids, cholesterol and histamine. Onion’s strong antioxidant activity is attributed to quercetin, kaempferol, myricetin and catechin (Muñoz Navarro B et al, 2005).
A group of researchers studied the antioxidant properties of organosulfur-compounds isolated from plants of the *Allium* genus, taking into account that the ability of these compounds to scavenge free radicals, such as DPPH, *in vitro* is concentration-dependant. Thiosulfonate groups are responsible for this process. However, the allyl groups (powerful electron donors) of allicin make this later compound more effective. In a comparative study about the antioxidant properties of onion and garlic extracts, it was found that the edible portions of onions were 15-times stronger antioxidants than garlic and that onion peel extracts were 240-times stronger antioxidants than garlic. Such a strongest antioxidant activity was attributed to the phenol hydroxyl groups in the flavonoids and phenol acids of onions. However, also important is the presence of organosulfur-compounds, such as diallyl-disulfide and its sulfur-oxides, which have the characteristic ability of scavenging electrons and free radicals. All of these components may have complementary or synergic effects (Muñoz Navarro B et al, 2005).

Therefore, onion extract is useful to formulate cosmetic products for the protection of skin and hair against oxidative processes.

**Antiinflammatory activity**

Wagner H. et al. (1990) found that nine thiosulfinates and four cepaenes isolated from onions and/or synthesized by them showed marked inhibitory effects on cyclooxygenase and 5-lipoxigenase, both enzymes involved in inflammatory processes.

Dorsch W et al. (1990) found that seven different synthetic thiosulfinates and cepaene- and/or thiosulfinate-rich onion extracts inhibited *in vitro* the chemotaxis of human granulocytes induced by formyl-methionine-leucine-phenylalanine, in a dose-dependent manner and at a concentration range of 0.1-100 microM. Diphenylthiosulfinate showed the highest activity and was found to be more active than prednisolone. These findings lead the authors to conclude that the anti-inflammatory properties of onion extracts are related, at least in part, to the inhibition of inflammatory cell influx by thiosulfinates and cepaenes.

Therefore, onion extract is recommendable to formulate cosmetic products with anti-irritation activity.
Hair growth stimulating activity

Sharquie KE & Al-Obaidi HK (2002) studied the effectiveness of topical crude onion juice in the treatment of patchy alopecia areata in comparison with tap water. The patients were divided into two groups. The first group (onion juice treated) consisted of 23 patients, 16 males (69.5%) and 7 females (30.5%) aged 5-42 years. The second group (control-treated with tap-water) consisted of 15 patients, 8 males (53.3%) and 7 females (46.6%) aged 3-35 years. Both groups were asked to apply the treatment twice daily for two months. Re-growth of terminal coarse hairs started after two weeks of treatment with crude onion juice. At four weeks, hair re-growth was seen in 17 patients (73.9%), and, at six weeks, the hair re-growth was observed in 20 patients (86.9%) and was significantly higher among males (93.7%) compared to females (71.4%) P<0.0001. In the tap-water treated-control group, hair re-growth was apparent in only 2 patients (13%) at 8 weeks of treatment with no sex difference.

The mentioned data suggest that onion juice may be helpful to formulate cosmetic products with hair growth stimulating activity.

COSMETIC APPLICATIONS

<table>
<thead>
<tr>
<th>ACTION</th>
<th>ACTIVE</th>
<th>COSMETIC APPLICATION</th>
</tr>
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<tbody>
<tr>
<td>Antimicrobial</td>
<td>Sulfur-containing compounds</td>
<td>Purifying</td>
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<td>Proteins</td>
<td>Antiseptic</td>
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<td>Phenol compounds</td>
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<td>Phenol compounds Sulfur-</td>
<td>Anti-aging</td>
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<td>Photo-protection</td>
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<td>Hair color protection</td>
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<tr>
<td>Antiinflammatory</td>
<td>Sulfur-containing compounds</td>
<td>Anti-irritation</td>
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<tr>
<td>Hair growth stimulation</td>
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<td>Hair growth</td>
</tr>
</tbody>
</table>

RECOMMENDED DOSE

The recommended dose is between 0.5% and 5%.
BIBLIOGRAPHY


Web sites:

www.fitoterapia.net [accessed may 2006].