Calendula oil

BOTANY

Calendula officinalis L. (=*Calendula officinalis* L. var. *prolifera* hort) is an aromatic annual plant, that belongs to the Asteraceae (Compositae) family. Typically, this plant grows about half a meter. The stems are straight, ramified. The leaves are oblong-lanceolate, hairy on both sides, 5 to 15 cm long, with toothed margins. The inflorescences are thick capitula or flower-heads (3-8 cm) surrounded by two rows of hairy bracts. The tubular, hermaphrodite, central flowers are generally, of a more intense orange-yellow color than the female, tridentate, peripheral flowers. The flower-heads appear all year long. The fruit is a thorny curved achene.

Calendula is native to the Mediterranean area (some believe it comes from Egypt) although it is widely spread throughout the world as an ornamental plant. Although it prefers clay soils, this plant will grow in every kind of soil, therefore being usually planted in urban flower beds and gardens.

Calendula oil is an oily extract produced by macerating *Calendula officinalis* flowers in sunflower oil (*Helianthus annuus*).

CHEMISTRY

Essential oils

Calendula flower-heads have variable essential oil concentrations: up to 0.12% in the ligulate flowers and up to 0.4% in the inflorescence receptacle. The flower-heads are rich in oxygenated monoterpenes and sesquiterpenes: carvone, geranylacetone, cariophyllene ketone, menthone, isomenthone, γ-terpinene, γ and δ-cadinene, cariophyllene, α and β-ionone, 5,6-β-ionone epoxide, pedunculatine, dihydro-actinidiolide, α-muurolene, etc.

Triterpene alcohols
Calendula capitula contain the following pentacyclic triterpene alcohols: arnadiol, faradiol, α y β-amyrin, faradiol-3-myristic acid, lupeol, taraxasterol, faradiol-3-palmitic acid, calenduladiol, etc.

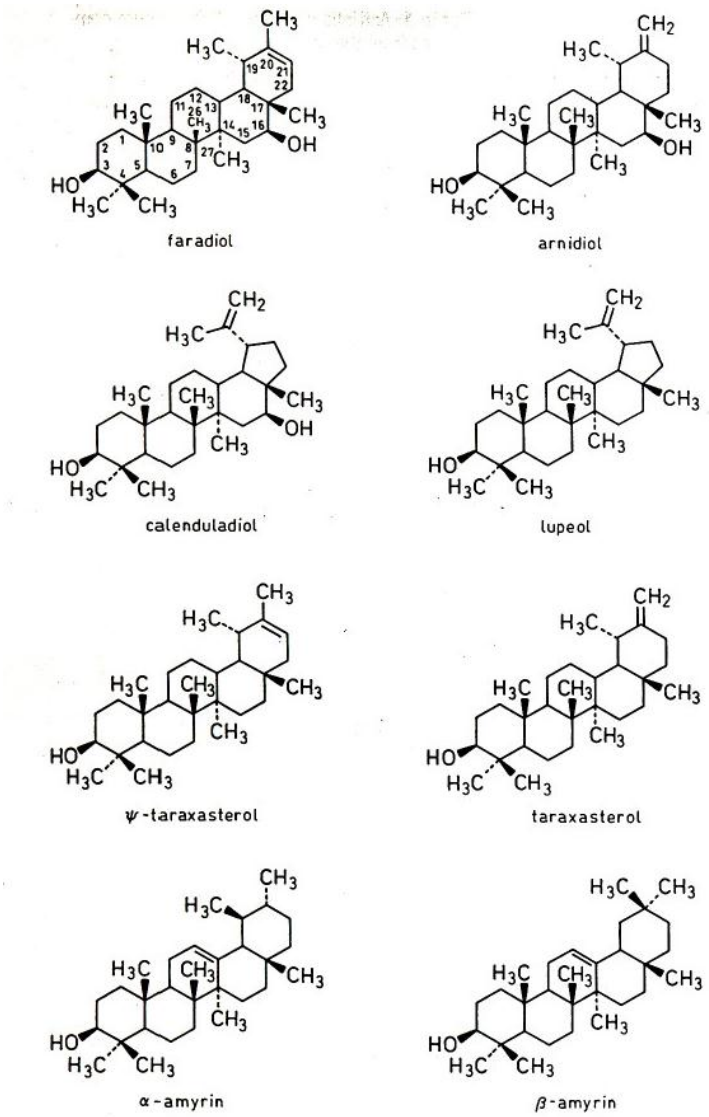

Fig.1. Chemical structure of terpenoids isolated from calendula flowers (Della Loggia et al., 1994).

Carotenoids
The proportions of carotenoids in ligulate flowers and receptacles are 0.078% and 0.017% respectively. These compounds include: calendulin, α-, β-, and γ-carotene, lycopene, rubixanthin, violaxanthin, citroxanthin, zein, chrysanthemaxanthin, flavochrome, flavoxanthin, auroxanthin, lutein, microxantina, 5,6 epoxy-carotene, etc.

TRADITIONAL USES

Even when its origins are still uncertain, the uses of calendula as a medicine and as a coloring were known to the old herbalists, especially Arabs and Hindus. Greeks, who started cultivating it more recently, used calendula flowers to decorate their feasts and to make garlands to honor their heroes. The botanical name, comes from *kalendulae*, the Latin word for the first day of the month in the Roman calendar, in reference to the plant's tendency to bloom at the beginning of almost every month.

Ancient Romans also called it *solsequium*, meaning “sun follower” because its flowers open at dawn and close at the sunset. Due to the high prices of saffron, ancient Greeks and Romans used dried calendula petals as a substitute. People in the Middle Ages used calendula extensively. Abbess Hildegard of Bingen (1099-1179) recommended it to treat impetigo and skin maculae. Albertus Mangus (1193-1280) considered this species to have great therapeutic value. It was incorporated in almost every herbarium of the time. Father Sebastian Kneipp (1821-1897) recommended local applications of calendula on ulcers, varices and maculopathy of every kind. During the North American civil war and the World War One, calendula cream and ointments were applied on wounds as an anti-inflammatory and antiseptic.

COSMETIC PROPERTIES

Anti-inflammatory activity
The topical use of calendula preparations is rather extensive in cosmetics as well as in dermatology because of its anti-inflammatory activity. The clinical efficacy of this plant has been long demonstrated. Della Loggia et al. (1994) used an experimental model (mouse ear croton-induced inflammation) and a product obtained by supercritical extraction to demonstrate that the lipophilic fraction (after removing saponosides and polysaccharides) produced the anti-inflammatory effects. A bioassay-oriented fractionation of this fraction showed that the anti-inflammatory activity was due to the triterpenoids, monools and diol esters, especially to faradiol monoesters. Unesterified faradiol, produced by hydrolysis, was found to be as active as indomethacin on this animal model.

In vivo studies using rats evidenced the anti-inflammatory activity (on inflammation induced by carrageenan and prostaglandin E1) and the inhibitory action on leukocyte infiltration (www.fitoterapia.net).

Calendula anti-inflammatory activity is strengthened by sunflower oil. The anti-inflammatory activity of sunflower oil is due to its vitamin E and linoleic acid content (48-74%).

- **Vitamin E**
  A study was carried out where a cream containing 2% α-tocopherol (vitamin E) was applied to rabbits for seven consecutive days. After the termination of this treatment, croton oil was applied to induce local irritation in the treated area. It was observed that the degree of inflammation, the magnitude of the lesion and the duration of the dermatitis in vitamin E pre-treated rabbits were significantly reduced as compared with those of control rabbits (Idson B., 1993).

- **Linoleic acid:**
  Dermatitis is a very common type of skin inflammation. The skin is the natural barrier we have to control the input and output to our body. Dermatitis is mainly due to the deterioration of the skin structure and integrity. Such integrity deterioration results in a larger than normal trans-epidermal water loss and is therefore responsible for the skin irritation. It has been demonstrated that patients with dermatitis have low tissular levels of all of linoleic acid polyunsaturated derivatives. A number of clinical tests demonstrated that local applications of linoleic acid (as well as its polyunsaturated derivatives) soothe the skin and reduce trans-epidermal water loss (Wright S., 1991). Conti A. et al. (1995) and Jiménez-Arnau A. (1997) also verified these properties of linoleic acid.

  Skolnik P. et al. (1977) carried out a study that demonstrated, in three cases, that topical applications of the linoleic acid-rich sunflower oil reversed the effects of chronic malabsorption-induced EFA deficiency, and increased the epidermal levels of linoleic acid.

Therefore, calendula oil is highly recommendable to formulate cosmetic products to treat sensitive and/or irritated skin.

Antimicrobial activity
This activity is due to the essential oil content in calendula.

All of the essential oils have antimicrobial activity to a greater or lesser degree. This activity can be measured by using the phenol coefficient, which rates the antimicrobial strength or weakness of a certain oil as compared with that of pure phenol (coefficient = 1.0). Phenol – a component of essential oils – shares some characteristics of alcohol, which result in antimicrobial activity. The highest the phenol coefficient of a certain essential oil, the strongest its antimicrobial activity. Different research studies have confirmed the antimicrobial properties of essential oils, especially on antibiotic-resistant bacteria, such as *Staphylococcus aureus*, which resists methicillin, or *Enterococcus faecium*, which resists vancomycin. The antimicrobial activity of essential oils is attributed to their main chemical components: citral (aldehyde), geraniol (primary alcohol), eugenol (phenol), menthol (secondary alcohol) and cinnamic aldehyde (aldehyde) (Hartman D. & Coetzee JC., 2002).

Essential oils show antiseptic effects against different pathogenic bacteria, even antibiotic-resistant strains. Some essential oils are also effective against the fungi and yeasts (*Candida*) that cause mycosis. The active doses are generally low. In general, the doses calculated for *in vitro* experiments may be used for external applications. Compounds such as linalool, citral, geraniol, or thymol are more antiseptic than phenol by 5, 5.2, 7.1 and 20 times respectively (Bruneton J., 2001).

The antimicrobial activity of calendula oil is strengthened by the antibacterial action of sunflower oil. This action of sunflower oil is due to its linoleic (48-74%) and oleic (14-40%) acids content. 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 was active against the bacteria *M.kristinae, S.aureus* and *Enterobacter cloacae* with a MIC of 1.0 mg/ml. None of both acids exerted inhibitory actions on Gram-negative bacteria. A synergistic effect of both acids against *S. aureus* and *M. kristinae* was observed (Dilika F. et al., 2000).

Therefore, calendula oil is highly recommendable to formulate cosmetic products with antiseptic activity.

Finally, we would like to mention that the book *Plants preparations used as ingredients of cosmetic products. Council of Europe, 1994*, includes a monograph on *Calendula officinalis*, where the following cosmetic properties and uses are attributed to calendula oily extract:

- emollient, soothing and protective. Recommended concentrations up to 10% for bubble bath, hand care preparations, irritated/cracked skin products and baby products.
- other possible effects of calendula oil are: wound healing, anti-irritant and antiseptic.

COSMETIC APPLICATIONS

Action	Active		Cosmetic Application
	Calendula	**Sunflower oil**	
Anti-inflammatory	Triterpenoids	Vitamin E Linoleic acid	-Sensitive/irritated skin
Antimicrobial	Essential oil	Linoleic acid Oleic acid	**-**Purifying -Antiseptic

RECOMMENDED DOSE

The recommended dose is between 0.5% and 5.0%.

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Web sites:
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www.ars-grin.gov/duke/ [consulted in December 2005].