

Sage



Taxonomy

Salvia officinalis L., Lamiaceae (Labiatae) (mint family).

Common names

Sage, garden or common sage, Dalmatian sage, red sage, true sage.

Botany

The genus *Salvia* is the largest genus in the Lamiaceae family and consists of more than 1000 species of perennial and annual shrubs. Almost all of them are herbaceous and the majority contain important biochemically active compounds that are used in the culinary, medicinal, and biotechnological fields. The name *Salvia* is derived from the Latin "salvere", which means "to heal". The species name *officinalis* is a Medieval Latin description denoting plants with medicinal or herbal uses. The species *Salvia officinalis* L. includes a variety of cultivars, each selected and cultivated for differences in flower size and colour, and varying flavours. The plant was described by Carolus Linnaeus in 1752 and 1753. Common sage is native to the Adriatic and Mediterranean area of the Balkan peninsula. It was first cultivated by the ancient Greeks who used it for medicinal purposes and has been distributed and cultivated throughout the Mediterranean region for over 2500 years. Garden sage is now grown in many regions of the world, primarily as a culinary herb. As a result, sage is commonly used in a number of cuisines of the Balkan, Middle Eastern and Italian region.

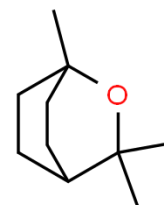
The common sage plant is a perennial shrub with a characteristic leaf venation and indumentum (dense hairy covering), giving it a silver-green velvety appearance. The shrub grows to a height of 0.6-1.0 meter and is typically as wide as it is tall. The leaves have an ovate base and apex with an entire (continuous smooth) margin and grow up to 90 mm long. Their petioles are sheathed and they are arranged as a whorl around a reduced upright stem. The plant produces white, blue, or purple flowers that bloom from late winter to early summer. Flowers are zygomorphic (only one plane of symmetry) and bisexual, with a superior ovary and pronounced single stigma and anther. The petals possess a prominent indumentum. Flowers are arranged in a whorl along a single pedicel, each with well-defined but small bracts. Peduncles are reduced but present. The seeds of sage are very small, brown, and usually spherical shaped.

World Production

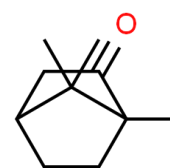
Common sage is one of the worlds most popular seasoning herbs. Large quantities are used by the commercial food industry. The plant is cultivated and farmed in numerous countries of the world. It is most extensively collected from the wild and cultivated in Yugoslavia, Albania, Turkey, Italy, Greece, the United States, Spain, France, Crete, Iran, Pakistan, Indonesia, Hungary and China.

Chemistry

Compared to other members of the Lamiaceae family, *Salvia officinalis* L. has a unique aroma profile. This profile is caused by the composition of the volatile compounds found in its essential oil. Common sage is considered to have the highest amount of essential oil compared to the other species of *Salvia*. The aromatic constituents of sage oil include eucalyptol (1,8-cineole), camphor, borneol, viridiflorol, linalool, cis-ocimene, α and β -thujone (toxic) and many others. More than 30 different constituents have been identified to date. Although α - and β -thujone are toxic, they can make up a large portion of sage oil (up to 60%). Sage essential oil is obtained by steam distillation of partially dried leaves. This results in a pale-yellow to colourless hydrophobic solution, which can be purified into a number of marketable products. The essential oil shows tremendous variation in the quantity of the principle constituents. For example, the quantity of eucalyptol can range from 5-55% and of camphor from 3-35%. In the plant, the essential oils are stored in the large number of trichomes (hair-like storage cells) that cover the leaf surface. In nature, these oils are thought to act primarily as a deterrent to pests. Mechanical damage to the leaves releases the distinctive sage aroma characterized primarily by α - and β -thujone, eucalyptol and camphor. Various cultivars have differing concentrations of these compounds and their cultivation depends on the desired aroma, taste and growth habit. Several chemical races of domesticated common sage have been recognized and oils with an α and β -thujone content exceeding 30% and camphor content less than 20% are most valued. The essential oil is widely used in the pesticide, pharmaceutical, flavouring, perfumery and cosmetic industries. Due to its very mild microbicidal properties, it is also used in toothpaste and mouth wash. In the processed food industry, the essential oil is often added to products as a seasoning.



Eucalyptol
(1,8-cineole)



Camphor

The presence of white, yellow and gold colours in the variegated leaves of certain cultivars is due to the inclusion or exclusion of particular pigments. Yellow colouration is caused by a high xanthophyll presence in the leaves, while white is caused by the absence of any pigment. The purple colouration of the 'Purpurascens' cultivar is due to the presence of anthocyanins. Sage contains numerous antioxidants including the genus specific phenolic acids salvianolic acid A and B. The leaves are also a natural source of flavonoids and polyphenolic compounds (e.g., carnosic acid, rosmarinic acid and caffeic acid) possessing strong antioxidant, radical-scavenging, and antibacterial activities.

Table 1: Characteristics of some sage cultivars.

Cultivar	Morphological Character				% Essential Oil (steam distillation)	Major Aromatic Compounds		
	Leaf	Stem	Flower	Other		Eucalyptol	Camphor	Thujone ($\alpha + \beta$)
'Alba' (White)	Dark Green	No change	White	No change	N/A	N/A	N/A	N/A
'Aurea' (Golden)	Variegated, Gold	No change	No change	No change	0.92%	47%	8%	2.4%
'Berggarten' (Broadleaf)	Larger, Dark Green	No change	No bloom	No change	1.05%	52%	8%	3.4%
'Extrakta'	Higher essential oil	No change	No change	No change	1.85%	55%	10%	3.3%
'Icterina'	Variegated, yellow-green	No change	No change	No change	1.01%	55%	9.5%	1.9%
'Lavandulaefolia' (Dwarf)	Smaller, Dark Green	No change	No change	No change	N/A	N/A	N/A	N/A
'Purpurascens' (Purple)	Dark Green, Purple	No change	Purple	No change	N/A	N/A	N/A	N/A
'Tricolor'	Variegated, white, yellow or green	No change	No change	No change	0.96%	46%	6%	3.2%

N/A = Information not accessible, no documented cases of extraction of these cultivars.

Adapted from Baydar, H., Kemal Sangun, M., Erbas, S. and Kara, N. 2013. Comparison of Aroma Compounds in Distilled and Extracted Products of Sage (*Salvia officinalis* L.), Journal of Essential Oil Bearing Plants, 16(1): 39-44; Hamidpour, M., Hamidpour, R., Hamidpour, S. and Shahlari, M. 2014. Chemistry, Pharmacology and Medicinal Property of Sage (*Salvia*) To Prevent and Cure Illnesses such as Obesity, Diabetes, Depression, Dementia, Lupus, Autism, Heart Disease and Cancer. Journal of Traditional and Complementary Medicine, 4(2): 82-88; USDA National Database Nutrient Release Standard Reference Report, 2015.

Nutrition

The nutritional value* of *Salvia officinalis* L. (Common Sage) per 100 g dried edible portion is:

Water	7.96 g	Sodium	11
Calories	1317 kJ	Zink	4.7
Protein	10.63 g		
Fat	12.75 g	Vitamins:	
Sugars (total)	1.71 g	Vitamin A	5900 IU
Fiber	40.3 g	Vitamin B1 (thiamine)	0.754 mg
		Vitamin B2 (riboflavin)	0.336 mg
Minerals (mg):		Vitamin B3 (niacin)	5.72 mg
Calcium	1652	Vitamin C	32.4 mg
Iron	28.12	Vitamin D	0 IU
Magnesium	428		
Phosphorous	91		
Potassium	1070		

*USDA National Nutrient Database for Standard Reference
<https://www.ars.usda.gov/ARUserFiles/80400535/Data/SR/SR28/reports/sr28fg02.pdf>

Uses

Common Sage has long been used for its culinary, medicinal and aromatic properties. The camphor aroma results in a pleasant minty smell that go with almost any meat-based dish. Sage is predominantly included in Mediterranean, especially Turkish, cuisine, including pork, chicken and pasta (gnocchi) dishes. The dried leaves and essential oil of sage are employed as seasonings for sausages, ground meats, stuffing, fish, honey, salads, soups, and stews. Sage is also used as a flavoring and antioxidant in cheeses, pickles, vegetables, processed foods, and beverages. The oil is used as a preservative to extend the keeping quality of fats and meats. Sage leaves are also used worldwide as a tea, Steeping the dried leaves in hot water results in the release of the pleasant tasting eucalyptol and camphor, resulting in a mild minty flavour with a bitter aftertaste caused by thujone. Dried Sage is often used in sauces and stock packets, adding a typical minty smell and subtle bitterness. Finally, sage is also used as a preservative of numerous low protein foods, including legumes and fowl meats. Culinary sage is well known as a good addition to garlic, mustard, tahini, oregano, pepper, mint and chickpeas.

As a medicinal plant, sage has traditionally been considered an antispasmodic, antiseptic, astringent, diaphoretic, expectorant, nervine, and tonic. The plant has also been used as a folk remedy against colds, diarrhea, enteritis, venereal disease, excessive perspiration, snake bites, sore throats, toothaches, and cancer. Sage has been reported to act as a bactericide and is used in mouthwashes and gargles. The oil is used in perfumes and cosmetics and as a natural insect repellent.

Harvesting and Quality Indices

Sage plantings last from two to six years, and the initial harvest is made in the first year. In subsequent years, two or three harvests are taken annually just prior to bloom.

Fresh Product

Fresh sage quality is determined by colour, appearance and aroma. Fresh leaves should be uniform in size, fully turgid, have a uniform green colour free from yellowing, blemishes, decay and insect or mechanical damage. They should also have a strong, characteristic camphor (minty) aroma. The leaves should typically be uniform in appearance, with a good bilateral symmetry.

Harvesting of fresh sage is done before blooming by pinching off leaves or snip off small sprigs from the tips of the plant. This ensures that the plant itself remains in good health, both promoting new growth and preventing flower blooming. Blooming causes leaves to lose their intensity. Any flower formation is immediately removed to prevent loss of production energy. Keeping the leaves whole and intact ensures that loss of volatile components is reduced to a minimum. During the first year, harvesting is light to ensure that the plant grows fully. After the first year, a few stalks should be left on the plant after harvest to ensure that the plant can rejuvenate. When fully established, one plant can be harvested up to three times in one season.

Dried Product

Harvesting of most large commercial sage operations is done by mechanically mowing 20 cm of the tips of the branches. Most of the harvesting is done before flowering commences as this is when the essential oil content is highest. Leaves and vegetative tops are dried in the shade or with low artificial heat to ensure retention of color and the quality and quantity of the volatile oil. Leaves and sprigs are dried to 12% moisture at 38°C. Alternatively, harvested material can be freeze dried (lyophilized) where the fresh product is frozen, followed by sublimation of the ice (transition of water from solid ice directly to gaseous water vapour) under vacuum. Dried leaves can be removed from the stems and stored in sealed containers.

Oil Product

Sage is harvested and distilled just before flowering commences for essential oil production. The harvesting practices for oil extraction are the same as for fresh and dry products. The primary goal is to ensure that zero mechanical damage occurs to the leaves, preventing release of volatile components from the trichomes. The best essential oils are obtained from steam distilling just the leaves.

Postharvest Handling & Care

Temperature control is the most important aspect of good postharvest management of fresh herbs and the best storage conditions for fresh sage is 0-10°C and 95-98% relative humidity. At 0-2°C it maintains excellent visual quality over a 2-3-week storage period. Fresh sage leaves are typically stored in an open or air circulating atmosphere to

prevent the buildup of moisture. The leaves are thoroughly washed prior to packing and sale, preventing the transport of pests and diseases. It is best to market and use fresh cut sage as soon as possible.

The dried leaves are packaged in airtight containers as soon as possible so they retain their colour and flavour. The dried and packed product should be kept at 10°C out of direct light. Dry sage freezes well and can also be stored frozen in airtight containers for up to two years. Vacuum packing of sage is also common as a storage method.

Essential oils are bottled and stored in a dry, dark and cool location for 12-18 months.

Ethylene

Sage is susceptible to ethylene, and in temperatures above 5-8°C causes rapid yellowing, wilting and loss of flavour. As a result, fresh sage should not be stored near ethylene producing fruit, as well as kept under cold storage conditions as described above.

Physiological Disorders

In general, sage is a hardy plant that does not typically present many physiological issues. Sage is capable of withstanding freezing temperatures during storage for a long period with minimal effect.

Postharvest Pathology

Postharvest ailments include decay, rapid decay by ethylene and surface molding. However, molding and bacterial decay is not very prevalent in sage, due to the natural presence of camphor and thujones.