REVIEW ARTICLE

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# *Salvia officinalis* Linn.: Relevance to Modern Research Drive

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**Abstracts:** Medicinal plants have been in use for millenniums by human race as potential source of natural first aids against different ailments. But somewhere, the danger of adverse reactions haunted many pharmaceutical giants, leading to rejections of potential leads having side effects making them inappropriate for human consumption, causing them huge losses. Thus Natural route, as a source posses an advantage of lower rejections and higher productivity. Recent times have seen an increase in surge for pharmaceuticals setting up Nutraceutical Segment (S.B.U), focusing developing medicines for commercial use. *Salvia officinalis* Linn (Lamiaceae) perennial evergreen shrub with woody stems, grayish leaves and blue - purplish flowers contains following phytoconstituents Furfural, Tricyclene, α-Pinene, Camphene, Sabinene, β-Pinene, 3- Octane, Myrcene, 3-Octanol, α-Phellandrene, α-Terpinene, *p*-Cymene, Limonene, (*Z*)-β-Ocimene, (*E*)-β-Ocimene, γ-Terpinene, *trans*-Linalool oxide, Terpinolene, Linalool, *cis*-Thujone, *trans*-Thujone, Camphor, Borneol, Terpinen-4-ol, 3-Decanone, α-Terpineol, *n*-Dodecane, *n*-Decanol, Isobornyl acetate, Bornyl acetate, Carvacrol, *n*-Tridecane, α-Cubebene, Eugenol. The present review is an effort to concise a report on this medicinal plant and an up-to-date manifestation on pharmacological relevance explored so far.

## INTRODUCTION

Traditional drugs are considered an important part of mankind's civilized system. The knowledge acquired via slow progressive expertise gained while handling plants by humans has lead to development of new science or in other words a new segment of therapy to deal with diseases and complications associated with anatomy and physiology. Traditional medicine though are used in different manners and is dependent from place to place, cultures followed and local beliefs, all over the world, but the significance of using medicinal plants into treating practices is a common inference. The main roadblocks for widespread popularity of traditional system have been mainly lack of proper governing body to regulate the practice in the deep areas of our society. [1] Recently a new light has come in form of agreement for having separate drug controller India for traditional medicine, leading to separate and focused decision making, in favor of building the standards for traditional medicines. [2] Many important texts emphasize use of medicinal plants in our traditional system of medicine like *Charaka samhita, Sushruta Samhita, Ashtangahridaya* (In Ayurveda). [3]

## *SALVIA OFFICINALIS L.*

Salvia is one of the largest families of plants from mint family, Lamiaceae, having around 700 to 900 species of shrubs, herbaceous perennials, and annuals. Figure 1

Out of many species available for Salvia, few important have been in use and given special preferences in practices; following are the list of few species,

- *Salvia apiana*
- *Salvia leucantha*
- *Salvia divinorum*
- *Salvia microphylla*
- *Salvia elegans*
- *Salvia miltiorrhiza*
- *Salvia fructicosa*
- *Slavia nemorosa*
- *Salvia hispanica*
- *Salvia sclarea*

Few of *Salvia species* are employed for ornamental use, among which *Salvea officinalis* and *Salvia splendens* have been popular ornamental plants for beautification of gardens and in usuage as decorative plant in celebrations. [4-5]

*Salvia officinalis* described in 1753 by Carl Linnaeus food substitute, for healing and mentioned in several texts for its medicinal properties. Currently in modern times it's been used as ornamental plant in garden. [6]

### Traditional Significance

The ancients and Arabians considered it as immortal substance. In many Greek and Roman physicians text it's mentioned as multipurpose healing plant. Hippocrates called sage 'sacred plant' [7] Famous sayings existed in ancient texts such as 'How men can can grow old who has sage in his garden' quoted in Chinese. The plant holds sacred place among traditional practitioners. It finds its place in food preparations as decorative element for poultry dishes. The leaves parts are used for sore throat and for gurgles. [8]

### Botanical Classification [9]

Sage was officially listed in United States pharmacopoeia from 1840 to 1900. *Salvia officinalis* has been in the British pharmacopoe since 1934, plus in the pharmacopoes of Austria, Czechoslovakia, Germany, Hungary, Yugoslavia, Netherlands, Poland, Portugal, Roumania, Russia and Switzerland. [10] The german commission E approved internal use for mild gastrointestinal upset and excessive sweating as well as for external use in conditions of inflamed mucous membranes of the mouth and throat. European scientific cooperative on Phytotherapy indicate its use for inflammations such as stomatitis, gingivitis, and pharyngitis, and hyperhidrosis conditions, thus signaling its value. [11]

### Morphology

Garden Sage or *Salvia officinalis* L. is a short lived semi-woody shrub that gets up to 2 ft (0.6 cm) tall with a similar spread. It has intensely aromatic, thick, woody, gray green or multicolored oval leaves to 3 in (7.6 cm) long. The leaves

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**Table 1: Scientific Classification – *Salvia officinalis* L.**

| | |
|---|---|
| Kingdom | Plantae |
| Superdivision | Spermatophyta |
| Division | Magnoliophyta |
| Class | Magnoliopsida |
| Subclass | Asteridae |
| Order | Lamiales |
| Family | Lamiaceae |
| Genus | *Salvia* |
| Species | *officinalis* |

**Tablr 2: Chemical Constituents *S.officinalis* L. [16]**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Moisture | 5.7 % | Protein | 10.2 % | Fiber | 16 % | Carbohydrates | 46.3 % |
| Total Ash | 7.7 % | Calcium | 1.8 % | Phosphorous | 0.09 % | Iron | 0.03 % |
| Sodium | 0.01 % | Potassium | 1.0 % | Vitamin A | 2395 I.U./ 100g | Vitamin $B_1$ | 0.75 mg/ 100 g |
| Vitamin $B_2$ | 0.34 mg/ 100 g | Vitamin C | 39.8 mg/ 100 g | Niacin | 5.7.mg/ 100 g | Calorific value | 415 calories/ 100 g |

are set on the stem and are 1 ½ to 2 inches long, stalked, oblong, rounded at the ends, finely wrinkled by a strongly-marked network of veins on both sides, grayish-green in colour, softly hairy, and beneath glandular.

Flowers are blue, lilac, or white, with two lips and borne in erectile axillary racemes.

The plant flowers from June to August with lip from flowers and have an ascending inflorescence. The inflorescence is raceme like, measures 10-30 cm long, composed of axillary reduced cymes that form false whorls (verticillasters) and rarely branched. The remote verticillasters are sessile and 4-10 flowered. The pedicle is upto 1 cm long. The sepal is bell-shaped, 10-15 mm long and 2-lipped with lower lip 2-dentate while upper lip 3-dentate. The fruit is composed of 4 nutlets. The nutlet is nearly globular to three-angled, measures upto 2.5. Mm in diameter, smooth and dark brown. The stems are square and have green color with hair.

The plants are wooded in the second year. The seeds are dark brown, oval and very small. It is reasonable winter suited, ever green bush, but can't survive extreme frost. [12-14]

### Culinary Significance

Sage or *Salvia officinalis* L. finds a special place in our foods. The plant has recognition in the Spice board India with emphasizing its broad medicinal properties and in culinary practices. It is used for flavoring meat, fish and poultry dishes along with implemented in decoration of these dishes. It is used as milt tonic, astringent and carminative. It is diaphoretic and antipyretic. Sage oil is used in perfumes as a deodorant and its oil posse's antioxidant property. [15]

### Chemical Composition

Further phytoconstituents present in the plant are Ethereal oil (thujone, chamfer, and terpenoids), Resin, tannins (Silvatannines), bitters, Flavonoids (6-methoxygenkwannine, Genkwanine, Hispiduline, Luteoline, Salviginine) and phenolic acids (caffeine acid, rosemary acid, labiatic acid), phenols, sesquiterpenoids, alcohols, aromatic aldehydes, camphene, limonene, mycrene, allo-ocimene, *cis* and *trans* –β-ocimene, paracymene, α-pinene, β-pinene, terpinene, terpinolene, α-thuyene, sesquiterpenoids like allo-aromadendrene, α- cadinene, β-caryophyllene, β-copene, α-corocalene, α-humulene, ledene, α-maaliene, selina-5,11-diene, *cis* and *trans* -2-methyl-3-methylene-hept-5-ene, 1-octene-3-ol, borneol, *p*-cymenol-8, linalool, terpine-1-ol-4, α-terpineol, β-terpineol, *trans*-thuyanol-4, viridoflorol, bornyl acetate, linalyl acetate, linalyl-isovalerate, methyl-isovalerate, sabinyl-acetate, thymol, caryophyllene-oxyde, 1,8-cineol, hexanal, aesculetine, Salvene. [14-16]

## PHARMACOLOGICAL ACTIVITY-AN UPDATE

### Analgesic Activity

(*Qu et al., 2012*) investigated pain relief assessment in the essential oils of plant *Salvia officinalis* L.The outcome of the results found four key essential oils mainly linalyl acetate, linalool, eucalyptol, and β-Caryophyllene responsible for analgesic activity in relieving menstrual pain. Thus can be widely employed for alternative and complementary medicine on primary dysmenorrhea. [17]

### Antibacterial Activity

(*Stefanovic et al., 2012*) investigated synergistic antibacterial activity of *Salvia officinalis* and *Cichorium intybus* extracts comparing it with commonly used antibiotics like amoxycillin and chloramphenicol. The bacterial strains used for study were *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis, Enterobacter cloacae, Klebsiella pneumonia and Proteus mirabilis*. The results were significant for all the strains, except *E.coli*. Thus signifying plant extracts role in antibacterial property over gram negative and gram positive bacterias. [18]

(*Generalic et al., 2012*) studied the antioxidant and antibacterial activity in Dalmatian sage (*Salvia officinalis*) and found the presence of phenolic compounds responsible for antibacterial activities against gram positive (*Bacillus cereus* and *Staphylococcus aureus*) and gram negative bacterias like (*Salmonella infantis* and *Escherichia coli*). [19]

**Figure 1:** *Salvia officinalis* L.

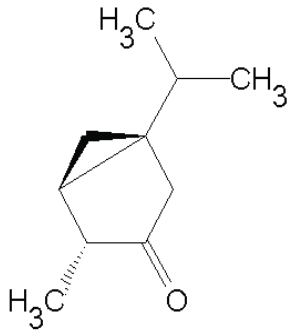


**Figure 3:** Thujone chemical structure

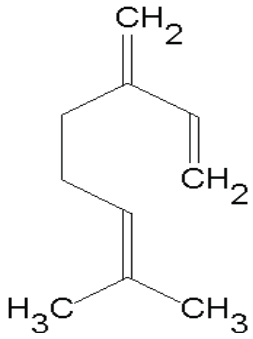


**Figure 4:** Mycrene chemical structure

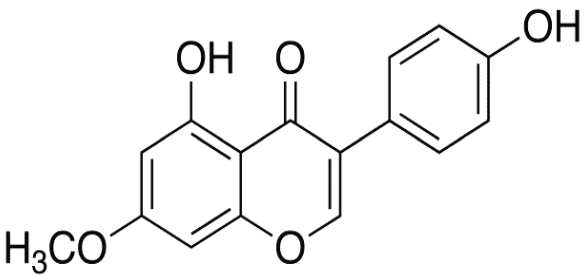


**Figure 5:** Genkwanine chemical structure

### Anti-inflammatory Activity

(*Bauer et al., 2012*) found anti-inflammatory activity in *Salvia officinalis* L. commonly used in traditional practices for its antiseptic and antiinflammatory activity. The researcher found two diterpenes acting as potent anti-inflammatory phytoconstituent acting as inhibitory action upon $PGE_2$ in a cell-free assay by direct interference with microsomal $PGE_2$ synthase (mPGES)-1. [20]

### Anti-nociceptive Activity

(*Rodrigues et al., 2012*) investigated the nociception effect of hydroalcoholic extract of the plant *Salvia officinalis* L. The experiment was conducted to record the extent of inhibition of nociception induced by glutamate, capsaicin and cinnamaldehyde that donot effect the locomotor activity of mice in the open field test. Carnosol (10mg/kg) and ursolic acid/oleanolic acid (30mg/kg) inhibited the inflammatory phase of formalin and the nociception and mechanical allodynia induced by cinnamaldehyde. Also it has postulated the antinociceptive property to be due to modulatory influence on TRPA-1-receptors. [21]

### Cancer Therapy

(*Ramos et al., 2012*) investigated free radical scavenging property in the plant extracts of *Salvia officinais* L. DNA damage induced by oxidative stress contributes to carcinogenesis, leading to potential mutagenesis. The researcher investigated anti-cancer activity of oxidative hydrogen peroxide and alkylating agents N-methyl-N-nitrosourea and 1, 3-bis-(2-chloroethyl)-1-nitrosourea agents in two colon cell lines. [22]

(*Janicsak et al., 2011*) investigated the cytotoxic effects of n-hexane, chloroform, and aqueous methanolic extracts of the leaves of *Salvia officinalis* L. against the human cervix adenocarcinoma (HeLa), Skin carcinoma, and breast adenocarcinoma cells using the MTT assay. This was subjected to bioactivity-guided fractionation, which yielded four abietene diterpenes (royleanone, horminone, 7-*O*-methyl-horminone and 7-acetyl-horminone), one triterpene (erythrodiol-3-acetate) and beta-sitosterol. [23]

(*Deeb et al., 2011*) investigated the anti-proliferative effect of NF-kappa B suppression in two important phytoconstituents mainly linalyl acetate (Ly) and alpha-terpineol (Te) in cell lining of colon cancer cells. Separate

treatment of plant extracts dose dependently downregulated the binding of DNA via NF-kappaB which led to potentiation of cell death induced by colon cancer drugs oxaliplatin and 5-Fluorouracil. [24]

**Antidiabetic potential**

(*Baddar et al., 2011*) investigated the anti-diabetic potential in thujone, which is a major constituent in Salvia species, and found it to correct the lipid profile e.g. cholestrol and triglyceride in diabetic rats. Oral treatment with thujone approx. 5 mg/ kg significantly adjusted the cholestrol and triglyceride levels in diabetic rats. [25]

(*Christensen et al., 2010*) investigated the activation property of diterpenes present in the plant *Salvia officinalis I* L. to the peroxisome proliferator-activated receptor (PPAR)γ. The diterepenes epirosmanol esters of 12-*O*-methyl carnosic acid and 20-hydroxyferruginol, viridiflorol, oleanolic acid, and α-linolenic acid had significant antidiabetic effects via activation of PPAR-γ. [26]

**Antioxidant Potential**

(*Walch et al., 2011*) analysed the antioxidant potential of the plant *Salvia officinalis* L.The traditional significance and widespread applicability lead to the evaluation of antioxidant potential pharmacologically. The sage extracts were chemically analyzed for polyphenolic content using liquid chromatography, for antioxidant potential using the oxygen radical absorbance capacity method, and for the Folin-Ciocalteu Index. Univariate and multivariate analyses showed that the antioxidant potential, which varied from 0.4 to 1.8 m mol trolox equivalents/100 ml, was highly dependent on rosmarinic acid and its derivatives. The FC Index also showed a high correlation to these polyphenols, and could therefore be used as screening parameter for sage tea quality. [27]

**Alzheimer Disease**

(*Obulesu and Rao, 2011*) investigated the mechanisms of plant extracts of *Salvia officinalis* L. in amelioration of Alzheimer disease and found it to be effective in treating the disease condition. [28]

**Dementia Amelioration**

(*Howes and Perry, 2011*) investigated the role of phytoconstituents in amelioration of dementia in the patients present in the several plants including *Salvia officinalis* L.These phytoconstituents dose dependently reduced the pathophysiological conditions leading to dementia. {29}

**Dermatitis Amelioration**

(*Takano et al., 2011*) investigated the role of herbal plant extracts from *Salvia officinalis* L.in inhibition of Nerve growth factor (NG-F) induced neurotic outgrowth in $PC_{12}$ cells. [30]

**Antimicrobial and Antifungal Activity**

(*Lixanddru et al., 2010*) studied the inhibitory effect of essential oils from the leaves of sage (*Salvia officinalis* L.) and found effective inhibition of *S.aureus, E.coli, Salmonella enterica Bacillus cereus, Candida albicans, Aspergillus niger, Penicillin* species. The plant extracts were found to be very effective antifungal and antimicrobial agents. [31]

**Viral Pharyngitis**

(*Hubbert et al., 2006*) investigated the double-blind randomized study on plant extracts from *Salvia officinali* L. effectiveness in viral pharyngitis. In the study, a total of 286 patients with subjective and objective evidence of pharyngitis were randomized.

In the study part 122 patients were enrolled, in the second study part 164 patients were included. The treatment duration per patient was 3 days, including one baseline visit and one first line visit. The efficacy and tolerability profile of a 15 % sage spray indicated that this preparation provides a convenient and safe treatment for patients with acute pharyngitis. [32]

**Antiangiogenic Activity**

(*Keshavartz et al., 2010*) carried forward with antiangiogenic properties in the plant *Salvia officinalis* L. Angiogenesis is a process in the promotion of cancer and its metastasis. The aerial parts of the plant *Salvia officinalis* L. were extracted with ethanol and its successive hexane, ethyl acetate, n-butanol, and aqueous fractions using human umbilical vein endothelial cells capillary tube formation and rat aorta models in a three-dimensional collagen matrix. The results were positive regarding antiangiogenic properties in the plant. [33]

**Plaque Control and Antigingivitis Property**

(*George et al., 2009*) investigated the herbal toothpaste having extracts of *Salvia officinalis* L. effectiveness in control of plaques and gingivitis as compared with conventional dentrifice. The result outcomes were that the herbal extracts significantly ameliorated the gingival index and plaque index scores. [34]

## CONCLUSION

Medicinal plants significance in amelioration of diseases has seen increase interest among the allopathic drug industry. The lower side-effects and more effective treatment outcomes has resulted into increase in surge towards natural leads for developing drug targets for curing diseases. The present review clearly thus puts light on the significance that *Salvia officinalis* holds for drug researchers to seek prospective drug molecular extractions leading to effective and efficient availability of cheap and powerful drugs. The toxicity related to drugs from natural sources has been reported in certain cases. The effective solution is to set up a standardized governing body to regularize the isolation, standardization and dosage formation of drugs from natural sources for effective implementation of goal of developing drugs from natural roadways.

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