

# **Nutritional, Therapeutic and Pharmacological Effects of Salvia Officinalis (Sage) on Health: A Novel Super Herb**

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## **ABSTRACT**

**Salvia officinalis is the most prominent medicinal plant of lamiaceae family among 900 species grown worldwide. Among all 900 species of salvia, the salvia officinalis and salvia fruticosa are most widely used for commercialization around the globe. It provides bioactive value to the health of humans through its anti-inflammatory, antidiabetic, anti-fungal, anti-spasmodic, antimicrobial, and anti-cancer activities. Salvia officinalis is loaded with antioxidants that are associated with several health benefits. Traditionally it is utilized for the treatment of several kinds of disorders including gout, autism, seizure, ulcer, rheumatism, paralysis, tremor and diarrhoea. It is used in various food and beverage industries to enhance the nutritional value of the product. Salvia officinalis is a perennial and herbaceous plant species consist of high protein (17g/100), low fat (3.46g/100) and loaded with several vitamins, minerals and essential oils in varying concentrations. Salvia officinalis predominantly comprise of essential oils such as 1,8 cineole, camphor and alpha thujone. Various extraction techniques have been identified from relevant studies and mentioned in this review article. The aim of the present study is to overview pharmacological, nutritional composition, therapeutic applications and supplementation of salvia officinalis in different food products. This review article is carried out by finding studies in Science direct, research gate, Google scholar, pub med, Medline.**

**Key words: Salvia Officinalis, Antioxidants, Autism, Anti- Spasmodic, Perennial.**

**Running Title:** Salvia officinalis a novel super herb.

## **INTRODUCTION**

Salvia officinalis commonly known as sage is the largest member of lamiaceae family. Its plant has gray-green edible leaves and flowers that vary in colour from blue and purple to white or pink and consist of more than 900 species around the globe. Salvia officinalis is an evergreen perennial sub shrub staple herb grows up to 60cm in height and is used in various cuisines worldwide due to its strong aroma and earthy flavor. During the roman times, it is known as a 'holy herb' and is employed in their religious rituals. It is commonly known by multiple names such as-sage, common sage, golden sage, kitchen sage, true sage, culinary sage, Dalmatian sage and broadleaf sage, most cultivated forms are- purple sage and red sage [1].Salvia made the vast history in nutritional, culinary and pharmacological purposes [2].Its name is derived from the Latin word salvarem which signify 'to cure' in reference to this, it posses' abundance of medicinal properties in preventing and treating various disease. It has been used to reduce perspiration, to enhance menstrual cycle regularity and lessen hot flushes in menopause, combat gastroenteritis, increase appetite and digestion, and boost cognitive functioning.[3].Additionally, it is rich in numerous essential oils i.e., cineole, borneol, thujone, camphor and viridiflorol which possess carminative, antispasmodic, antiseptic, antihydrotic and astringent properties [4].

Sage being a novel super food has been incorporated in various value added food products such as biscuits , herbal tea , mayonnaise , cheddar cheese, ice creams, cake due to its remarkable antimicrobial property and to enhance the nutritional value of theproducts[5]. Sage tea has a variety of health benefits, including treating digestive and circulatory problems, bronchitis, cough, asthma, angina, and mouth and throat inflammation, depression, excessive sweating, skin and many other disease[6].Various extraction techniques have been used by industries to obtain the different sage product i.e., hydro distillation/steam distillation, soxhelt extraction , infusion , solid – liquid extraction, UAE(ultra sound –assisted extraction), MAE(microwave –assisted extraction), SC-Co2(supercritical extraction). After using these extraction techniques

researchers analyzed that hydro distillation/ steam distillation is one of the oldest and most usual technique which is basically used for extracting the essential oils whereas, other techniques also have advantages but are limited by numerous disadvantages such as- high equipment cost , time consuming , high cost, low extraction efficiency[3].Moreover sage comprises of several bioactive compounds that are split into monoterpenes,diterpenes, triterpenes and phenolic components. Phenolic components are further divided into two groups: phenolic acids (caffeic, vanillic, ferulic, and rosmarinic acids) and flavonoids (flavonoids are compounds that include phenolic acids) (luteolin, apigenin and quercetin) [7].According to proximate composition(per 100g) , sage consist of 17g of protein ,3.46g of crude fat, 57.87 g of carbohydrate,35.96g of crude fiber,9g of moisture, 12.59g of ash [2].

*Salvia officinalis* has achieved prominent place in our foods due to its strong aroma and earthy flavor. It is used for flavoring meat, fish dishes and for poultry stuffing. Leaves extract of salvia were utilized in dressing salads.[8]In Valencia region of Spain, salvia officinalis is used for various purpose like-its hot tea is popular for its various properties like detoxification, cold, throat inflammation and moreover, for the treatment of skin diseases. Leaves of salvia officinalis were utilized for the dual purpose i.e. for spice and extraction of essential oil. [9]

*Salvia officinalis* (sage) at Greeks and Romans was utilized in many different ways like in meat preservation ,making tea with the help of its leaf extracts for curing ulcers, sore throats, laryngitis. It also helps in boosting memory power. [10] [11].Traditionally, salvia officinalis was used in herbal tea for healing stress and respiratory disorders at Brazil and South East Asia region. Moreover, its condiments and beverages were developed to improve cognitive ability. [12] [13] [20] [21].

*Salvia officinalis* considered to possess remarkable antiseptic property to cure the wounds. Its tea prepared and acts like a good stimulant, sedative and analgesics. [14][15]. At Jordan, researchers found leaves extract of salvia officinalis useful in several therapeutic ways. Its hydrosol was utilized as veterinary medicine for mastitis. [16].Whereas, it is known as medicinal herb at Europe and Latin America due to significant role in treating several diseases like- stress, indigestion, bloating, acidity, sunburn, bronchitis, Alzheimer's[17][18][19] convulsion, high blood pressure and numerous other nerve related disorders.[22][23]. The aim of the present study is to overview pharmacological, nutritional composition, therapeutic applications and supplementation of salvia officinalis. Salvia officinalis flower Salvia officinalis leaf Salvia officinalis plant.

## **METHODOLOGY**

The present study is carried out by using a proper and systematic search on the medicinal plant sage (*salvia officinalis*). This applicable data is recognized through searching on PUBMED, Google Scholar, Research gate and Science Direct.

### **Nutritional composition of salvia officinalis**

*Salvia* is considered to be the most nutritious herb worldwide due to its high carbohydrate; high fibre, high protein (17g/100g) and low fat content (3.46g/100g) whereas it showed the distinctive concentration of iron (84.0mg/100g), calcium (894.2mg/100g) and zinc (5.4mg/100g). However, it contains low amount of sodium and potassium (i.e. 19.8, 34.6mg/100g).*Salvia officinalis* also provides a good considerable amount of B-group vitamins in varying quantities of B3, B6 & B12 (i.e. 3.2, 1.5, 0.3mg/100g) respectively [2].*Salvia officinalis* contains volatile oils such as camphor (23.3%), alpha-thujone (22.8), scalareol(10.4%), beta-thujone(9.96%), 1,8- cineole(7.83%),gamma-selinene(7.73%),alpha-humulene(5.59%), caryophyllene(3.16%),borneol (3.0%), limonene ep (1.0 percent ).[24]It is stated that salvia officinalis comprises of 12.16% of moisture content and the yield of essential oil is 0.93% . [25]*Salvia* possess total ash 7.7%, phosphorus 0.09% vitamin A 2395 I.U/100 g ,niacin 5.7mg/100g,vitaminb12 0.34mg/100g.,VitaminC39.8mg/100g,Vitamin B1 0.75mg/100g,calorific value 415calories/100g.[8]Eman et al has postulated salvia officinalis contains 8.512% of ash respectively.[26]

### **Therapeutic applications of salvia officinalis.**

Historically, *Salvia* has long been used as an antiseptic, anti-scabies, anti-syphilis, and anti-inflammatory agent in traditional medicine due to its antibacterial qualities. However, it is frequently used to treat skin and eye problems. [27]Since, many years salvia has been utilized to treat several liver diseases in china. [28] Its tea has been used to treat a variety of ailments, including digestive and circulatory problems, bronchitis, cough, asthma, angina, mouth and throat inflammation, depression, excessive sweating, and more. Its oil has been used to treat a variety of ailments, including those affecting the neurological system, heart, and blood circulation, as well as the respiratory, digestive, metabolic, and endocrine systems. [1] *Salvia Officinalis* has Antihyperlipidemic, Anti-diarrheal, Anti-oxidant, Anti- diabetic, Anti-bacterial, Anti-cancer, Anti-anxiety and Anti-inflammatory effects.

## **THERAPEUTIC APPLICATIONS OF SALVIA OFFICINALIS**

### **Antibacterial activity of salvia officinalis**

Salvia is known to slow down the growth of bacteria due to its eminent antibacterial property and it was analyzed through a technique known as GC-MS against the following bacteria's- *Bacillus cereus*, *Bacillus megatherium*, *Bacillus subtilis*, *Aeromonashydrophilla*, *Aeromonassobria* and *Klebsiella oxytoca*. [29]

### **Antidiarrheal activity of salvia officinalis**

Salvia officinalis acts as an anti diarrheal agent by slowing down the bowel movement and allows nutrients to be absorbed into body. It was determined through an experimental study undertaken over diarrheal infected mice The crude extract of salvia officinalis has shown wonder in healing the diarrhoea hence, it proved to possess antidiarrheal and antispasmodic properties. [30]

### **Antioxidant activity of salvia officinalis.**

Salvia officinalis is accounted as a good antioxidant herb as it helps to prevent the cell damage caused by free radicals. It was incorporated in turkey meatball to the some extent and is stored at 4 degree Celsius for at least 9 days of period. Results showed the high antioxidant activity of sage extracts due to the presence of phenolic compounds (4.72mg of Gallic acid) (GAE/100g dw) with inclusion of flavonoids(20.47mg GAE/100g dw) and phenolic acids(8.14mg GAE/100gdw)respectively.[31] The antioxidant activity of oregano and sage were tested by using the two methods-the crocin test andracimat test. It was determined that sage has a very high antioxidant activity as compare to oregano sample. [32].Antioxidant activity of salvia officinalis leaves were examined by 2,2 -diphenyl -1-picrylhydrazyl(DPPH) radical scavenging test and beta carotene linoleic acid bleaching assay. After a month duration of salt treatment testing with varying concentration found that salvia has tremendous antioxidant property. [33]

### **Anticancer activity of salvia officinalis**

Abnormal multiplication of cells in human body is known as cancer. Furthermore, the effectiveness of sage tea proved to be beneficial in colon cancer prevention and modulation of epigenetic events due to its anti cancerous property. [34] The anticancer property of herbaceous plant salvia officinalis has been investigated. The result of the comparative study showed salvia officinalis and salvia miltiorrhiza both possess anticancer property due to the presence of rosmarinic acid. [35] Women were infected with breast cancer were medicated with hydro alcoholic sage leaf extract till 4 weeks. After the 4 weeks of administration it was observed that salvia officinalis helps in preventing breast cancer. [36] Soxhlet method for sole extraction and performed phytochemical and thin - layer chromatography test was done to determine the effect of salvia officinalis medicinal herb over oral squamous carcinoma cells. [37]

### **Anti- inflammatory activity of salvia officinalis.**

Salvia officinalis fortified foods supposed to be a good source of anti inflammatory substance, which can help in reducing the effect of inflammation .Due to the presence of ursolic acid in salvia officinalis considered to be the good anti-inflammatory substance in the treatment of various inflammatory diseases. [38]Utilization of aqueous and butanol extracts of salvia officinalis leaf was done to determine its anti-inflammatory action over gastrointestinal pain. Founded that the salvia officinalis leaf of both the extracts possesses analgesics as well as anti - inflammatory effects and provided relief from the pain. [39] Salvia is an excellent source of essential oils which plays a significant role in reducing the inflammation was determined through hydro- distillation technique.[40] carrageenan -induced pleurisy test[41].

### **Antiviral effect of salvia officinalis.**

Due to the ongoing viral infection around the globe such as- covid -19 pandemic, researchers took a trial study on the essential oils of two medicinal plants i.e., *lavandulaan justifolia* (lavender) and *salvia officinalis* (sage) were utilized to analyze their antioxidant , anti-inflammatory and antiviral property against the avian influenza H5N1 virus through GC-MS technique. The result of the study showed that salvia produces the highest level of essential oil yield 1.3% than lavender 1%.Due to the presence of essential oils in both salvia and lavender possess the anti- inflammatory, antioxidant and antiviral properties. [42]

### **Antihyperlipidemia effect of salvia officinalis**

Salvia is a crucial food ingredient beneficial in reducing lipid levels in blood. The randomized double-blind placebo-controlled clinical trial was undertaken on 67 hyperlipidemic patients with the age group of (56.4+\_30.3) years to evaluate the efficacy of sage leaf extract by using one (500mg) capsule for every 8 hr till 2 months. Hence, it was proved to be helpful in lowering the blood levels of total cholesterol and triglyceride. Simultaneously, there was a rapid increase in the level of HDL with no side effects respectively. [43]

#### **Antifungal effect of salvia officinalis**

Due to the presence of camphor a main component in salvia officinalis reflects to exhibit the antifungal property against the strain of Botrytis cinera pers. [15]. Effect of salvia officinalis was determined chemically against two fungi (verticillium and penicillium) in varying concentrations of essential oils present in salvia officinalis found to possess the antifungal property. [44]

#### **Anti - anxiety effect of salvia officinalis.**

Intense and excessive worry related to everyday situation leads to an increase in rapid heart rate, breathing and sweating occurs. After consuming food incorporated with extracts of salvia officinalis observed to have mimic in the symptoms of individual suffering with anxiety. Double blind placebo crossover study was performed over 30 healthy participants for consecutively 3 days. The result of the study concluded that salvia possess both invitro cholinesterase inhibiting properties and increase in mnemonic performance and manage mood in healthy young participants. [45]. After the consumption of salvia officinalis extracts found to have the remarkable improvement in enhancement of memory. [46]

#### **Anti diabetic effect of salvia officinalis**

Due to rapid increase in cases of diabetes around the globe, researcher found the novel super herb (salvia officinalis) to be effective against diabetes due to presence of bioactive components that possess its anti diabetic property. For 14 days, sage extract at various dosages (0.1, 0.2, and 0.4g/kg body weight) and glibenclamide (600ug/kg) were given orally. In streptozotocin-induced diabetic rats, there was a decrease in serum glucose, triglycerides, total cholesterol, urea, uric acid, creatinine, ast, alt, and increased plasma insulin, but not in normal rats. [47]. Behradmanesh et al postulated a study to examine the hypoglycemic effect, glycosylated hemoglobin (HbA1C), lipid profile, liver & kidney function test of salvia officinalis double blind clinical trial test was carried out over 80 type 2 diabetic patients at least 3 times a day for 3 months.. However, salvia officinalis proved to be helpful in reducing the 2hour post prandial glucose and cholesterol level. [48]

#### **Antispasmodic effect of salvia officinalis.**

Salvia officinalis known to have good amount of crude extracts which helps to provide the relief from spasm of involuntary muscle. To investigate antispasmodic effect of salvia officinalis an experimental study was undertaken on isolated ileum of rabbit. It was observed that salvia officinalis showed the significant antispasmodic effect. [49]

### **EFFECT OF SALVIA OFFICINALIS ON VARIOUS DISEASE**

#### **Obesity**

Accumulation of excessive fat in the body leads to the condition called obesity which is nowadays more prevalent among individuals worldwide. Researchers utilized 3 medicinal herb i.e. Hypericum perforation, salvia officinalis and calendula officinalis to determine their effect on the cardiovascular disease risk developed in obese rats. After the investigation, it was concluded that the infusion of the entire 3 medicinal herb proved to be helpful in reducing the body weight, abdominal fat, decreased serum triglycerides, total cholesterol and low density lipoprotein. [50]

#### **Alzheimer's disease**

Salvia officinalis played a significant role in the treatment of an autoimmune disease. Alzheimer's disease is a neurological disorder that gradually destroys cognitive memory and thinking skills. A controlled trial study was undertaken on the patients suffering with mild to moderate Alzheimer disease between the age group of 65 and 80 years and provided them with 60 drops/ day of salvia officinalis extract over a period of 4 months. The result of the study stated that the extract of salvia officinalis has proved to be fruitful in controlling the mild to moderate Alzheimer's disease. [51]. Another study was performed over participants.

It was observed that extracts of salvia officinalis showed the optimistic results and proved to be helpful in combating with Alzheimer's disease. [52] Furthermore, a comparative study was conducted to analyze the effect of salvia officinalis and salvia lavandulae folia on memory cognitive impairment and Alzheimer's disease. It was observed that both the species of salvia are beneficial in the treatment of neurodegenerative illness. [53]

#### **Autism**

Autism occurs due to the impairment in the ability to communicate and interact. Salvia officinalis contains valproic acid and essential oils commonly known for the treatment of autism. Guenne et al carried a study on rats to detect the effect of salvia officinalis on human neuropsychiatric disorder i.e. (Autism or autism spectrum disorder). The result showed that salvia officinalis essential oil remarkably found to be useful for the treatment of autism spectrum disorder. [54]

### **Effect of salvia officinalis extracts on the symptoms of postmenopausal women**

Salvia possess phytoestrogen known to have estrogenic property that helps in the reduction of postmenopausal symptoms. The study undertaken evaluated the effect of salvia officinalis over postmenopausal women complaining about the symptoms are provided with 100mg of tablets made up of salvia officinalis extracts were advised to take 3 tablets for at least 3 months. After investigating through paired t-test, ANOVA and performed questionnaires. Researchers determined that salvia officinalis (a medicinal herb) has the ability to alleviate menopausal symptoms such as night sweats, palpitations, flushing, muscular and joint pain, sadness, anxiety, and sleep difficulties, among others.[55]. Another study was performed over 30 post-menopausal, aged 46-58 year. Whereas, the study revealed that salvia officinalis is an effective herbal medicine for the symptoms of postmenopausal women. [56] Consuming fresh salvia extracts tablets helps in reduction of symptoms and increase in the tolerability and effectiveness among 50% women within 4 weeks of trial study. Conclusion of the study stated that utilization of fresh sage extracts in the form of tablet showed the positive results for the treatment of post-menopausal women. [57]

Demonstration of estradiol hormones and other menopausal symptoms were continually observed after the initiation of the intervention .After the completion of 8 weeks duration, significant decrease in the symptoms were detected as compared to the control group whereas estradiol levels were remained same. Result of the study revealed sage is helpful in treating postmenopausal symptoms. [58]

### **Utilization of salvia officinalis.**

Salvia officinalis being a versatile herb utilized in different fields. Due to its distinctive flavour is utilized in cooking. Furthermore, can be considered as a useful ingredient in cosmetics, soups, perfumes, insect repellent to apply on skin. Due to its magnificent medicinal properties used to provide relief in digestion (especially fatty meats), sore throat and also in lowering the blood sugar. Overall, its utilization in a right way can do wonders on the human body. [59]

### **Effect of salvia officinalis shelf life on various food products**

Shelf life is a major component for any food product .It is referred to as a time span under the favourable storage conditions in which food remains sustainable for human consumption. Whereas, salvia officinalis has excellent shelf life due to which it can be incorporated in any food items. An experimental study was carried out to analyze the effect of salvia officinalis (sage) (0.3 and 0.6%) sample with high pressure processing on the antimicrobial and antioxidant quality of prepared beef burger chilled and stored up to 60 days. It was founded that there was high occurrence of lipid oxidation in all the samples at the time of storage. Simultaneously, after the addition of sage powder in all the samples of beef burger resulted in decrease lipid oxidation which is processed under high pressure and was acceptable by all. [60]. Similarly, mayonnaise prepared with sage at different concentrations of (100,200 and 400ug/g) was evaluated through sensory and chemical method. It was concluded that mayonnaise sample of (400ug/g) treated with sage extract revealed the highest panel score during storage period and also possess excellent natural antioxidant effect on the stability of mayonnaise. [61]. Furthermore, rainbow trout fillet was prepared by using fish and sea foods which contain high level of moisture, free amino acids and an unsaturated fatty food that makes it contaminated. To avoid the spoilage and improve the shelf life of rainbow trout fillet. Salvia officinalis extract was supplement in the product which significantly lowers the microbial growth in fish fillet also enhancement in the shelf life of the product was observed. [62]. Under the favourable aerobic conditions microbiological stability of fresh pork sausages was incorporated with salvia officinalis essential oils and stored for at least 8 days, observed a significant reduction in the microbial growth of fresh pork sausages respectively. [63]

### **Supplementation of salvia officinalis in different food products.**

Due to its versatile properties it is incorporated in different food items. Eman et al developed the most famous dairy product labneh of Middle East, fortified with sage powder and olive oil as they are good source of antioxidant and possess more health benefits than traditional yoghurt. Showed the optimistic results and was acceptable by the entire panellist. [26]. Simultaneously supplemented the yoghurt, skimmed milk and cheese with the milled herb of aqueous extract(10% w/w) with varying concentrations like 1,2 or 3% (w/w) of turmeric , sage and marjoram . Study revealed the tremendous results respectively. [64]. However developed the butter made from sour cream and supplemented with 2% of dried herb (sage and rosemary) to evaluate the storage stability. On the basis of findings of the study it was connoted that the product supplemented with sage and rosemary herb helped in increasing oxidative stability. [65] A herbal cocktail was developed with salvia officinalis to prevent stroke and other cerebrovascular disease. Experimented this herbal cocktail over hyperlipidemic rat model, it was observed that cocktail supplemented with salvia officinalis proved to be beneficial in lowering the serum total lipid , cholesterol, LDL levels.[66] Salvia officinalis herbal cocktail Ice creams and cakes were developed using sage hydrosol powder to improve the quality. Incorporation was done at 3 varying concentrations 0.5%, 1% and 2% respectively. On the basis of antioxidant capacity test it was deduced that enrichment level of ice creams was higher as compare to cakes. [67] Salvia officinalis tea A healthy and nutritious corn- based snack was fortified with salvia

officinalis (seed). It was observed that saliva officinalis seed flour proved to be beneficial in decreasing the total starch content and increasing the total dietary fibre which was acceptable by all. [68]

#### **Preservative effect of salvia officinalis.**

Preservation is done to protect any food item from decaying by the effect of microorganisms. The effectiveness of salvia officinalis(sage) against various bacteria's were evaluated. Based on the obtained results, study suggested that salvia officinalis(sage) aqueous extract was most effective against bacterias like-Bacillus mycooides, Bacillus subtilis, Enterobactercloaceae and proteussp. whereas, most resistant was Escherichia coli(40mg/ml).[69].Hernandez et al. analysed the preservative effect of saliva officinalis through hydro distillation and steam distillation techniques

against various bacteria's likewise enterobacter agglomerans, citrobater freundii. However, outcome of the study revealed that saliva officinalis possess excellent antibacterial property can be used in food & pharmaceutical industries. [70]

#### **CONCLUSION**

Salvia officinalis is one of the most prominent natural medicinal herbs known for its strong aroma and earthy flavour. It contains powerful antioxidants found to be effective in slowing down the rancidity process in various food products. Salvia officinalis possess many desirable therapeutic applications such as antimicrobial, antifungal, antidiabetic, anti-cancer, anti-inflammatory all have been illustrated in this review paper. It has been used to treat various diseases including obesity, autism, Alzheimer's, diabetes and cancer. Each of these properties of salvia officinalis has played a key role in the advancement of human health. Due to the excellent antimicrobial and nutritional property of salvia officinalis has been incorporated in several food products. Further, investigations are needed to provide the additional clinical evidences for the use of salvia officinalis against cancer and other neurological disorders.

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