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Review Article

A Comprehensive Review on The Pharmacological Potential of Salvia Splendens

Yogini Raut*, Dr. Anjali Wankhade, Dr. Vivek Paithankar

Department, of pharmacology Vidyadhari College of Pharmacy, Amravati India.

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ABSTRACT

Salvia splendens Linn. (Family: Lamiaceae), also referred to as "red sage" or "scarlet sage," has long been utilized in traditional medicine systems to treat a variety of illnesses. Brazil and several other Asian nations, including China and India, are home to S. splendens plants. The most significant family of medicinal plants, Lamiaceae (Labiatae), has been utilized in traditional medicine to treat cardiac problems. Essential oils, extracts, or separated components (polyphenols, phenolic compounds, terpenes, iridoids, etc.) are utilized from these primarily fragrant plants. The mechanism of action against cardiovascular diseases (hypertension, angina pectoris, hyperlipidemia, thromboembolism, coronary heart disease, heart failure, venous insufficiency, and arrhythmia) as well as the cardioprotective effects of Lamiaceae and their active secondary metabolites will be covered in this review. Using labiatae as food or as food additions (like spices) may lower the risk of diabetes, cancer, and cardiovascular illnesses. The article also includes a description of this strategy. Research on creating novel, safe, and effective natural products from the Lamiaceae family—a rich source of flavonoids and other active compounds—is encouraging and could help patients with heart disease and other associated conditions avoid or treat their condition. Salvia splendens methanolic extracts' chemical characteristics, with a focus on their cytotoxic, antifungal, and antioxidant properties.

INTRODUCTION

The utilization of therapeutic plants has garnered more attention recently. Multinational corporations are now looking to the plant kingdom to synthesize drugs and physiologically active lead compounds. More than 800 plants are utilized as traditional treatments for a wide range of illnesses, according to ethnobotanical data. Naturally, herbal medicine is the main form of treatment in many regions of the world and is currently experiencing resurgence in popularity in the west. [1] As the

***Corresponding Author:** Yogini Raut
Address: Department, of pharmacology Vidyadhari College of Pharmacy, Amravati India.
Email ✉: yoginiraut2018@gmail.com
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world's population grows, traditional Chinese, Ayurvedic, and Unani medical systems are expanding globally. The entire salvia genus is frequently referred to by either of the two popular names, salvia or sages. Both come from the Latin word salvus, which means "safe," "whole," or "health" and alludes to the medicinal qualities of certain plants, particularly the common sage salvia officinalis. This blue-flowered salvia was a staple in medieval gardens and is still grown as an ornamental, flavoring, and medical remedy in herb and vegetable gardens today. Numerous biological activity, including antibacterial, fungistatic, virus-tatic, astringent, and anti-hyrotic properties, have been described for Salvia species. However, there are some studies about the antioxidative qualities and hypoglycemic effects.wound healing, and anti-inflammatory activity. [2] The herb has also historically been used as a powder, decoction, or infusion, either by itself or in conjunction with other therapeutic plants. Nowadays, commercial medicines have often been standardized extracts of the entire plant in controlled therapeutic trials. The plant has been shown to have hepatoprotective, antioxidant, antidiabetic, analgesic, and anti-inflammatory properties. [3] Salvia splendens' claimed advantages require cautious scrutiny because many of the diseases it is used to cure in traditional medical systems are thought to be self-limiting. In addition to confirming the medicinal effectiveness of S. splendens, this review highlights areas that require more research and summarizes recent scientific results. Description of the plant "Annual" salvia is a delicate tropical perennial that is usually planted in warm climates. Annual bedding plant. S. splendens arrests the eyes with a striking profusion of little red flowers towering over a pointy triangle leaves. This plant is commonly known as scarlet sage or red blazer and is a member of the Lamiaceae (Mint) family. [4]

Scientific Names	**Salvia Splendens**
Common name(s)	Red Salvia, Scarlet Salvia, Scarlet Sage, and Vanguard
Family	Lamiaceae/Labiatae (Mint family)
Annual Height	8 inches to 3 ft
Flowering season	Late spring
Flower color	Red, Purple, and White
Taxonomic classification:	
Kingdom	Plantae
Class	Eudicots
Sub Class	Asterids
Genus	Salvia
Species	splendens.

Additionally, S. splendens is used to treat burns, cancer, constipation, convulsions, delirium, diarrhea, dysuria, epilepsy, gravel, hematuria, pimples, and glandular tumors. It is also used to treat cancers of the abdomen, glands, liver, stomach, and neck.[5] According to Ayurvedic medical systems, the root is used to treat colds and coughs, while the seeds are associated with emesis, dysentery, hemorrhoids, and colic diseases. In that place, the leaves are used to treat wounds and soothe irritated skin. Brazilian herbal medicine uses the leaves to treat pain and inflammation and the seeds as an antipsychotic. Studies on pharmacology Antidiabetic action Streptozocin (STZ)-induced diabetic rats were used to test the antidiabetic effects of the methanolic extract (SSME) and aqueous extract (SSAE) of the aerial portions of S. splendens at oral doses of 100 and 200 mg/kg. By lessening the impact of glycemia in rats with STZ-induced diabetes, both extracts had a statistically significant effect when administered orally.[6]These results point to the S. splendens extract's strong antihyperglycemic potential in improving diabetic rats' circumstances. The

hypoglycemic potential of S. splendens leaves was examined. When tested on healthy albino rats, they demonstrated pronounced hypoglycemia action. Anticoagulant action and toxicity According to toxicological research done on an aqueous extract of S. splendens, popularly known as red sage, the medication only becomes hazardous at larger dosages and results in bleeding. S. splendens has an LD50 of 1287 mg/kg. Anticoagulant properties are possessed by S. splendens. The clotting time is increased by 10 to 15 seconds to 35 seconds by the aqueous root extract of S. splendens. As a result, the plant's parts—flowers, aerials, and roots—determine the anticoagulant action.Hepatoprotective action protective effects of S. splendens aqueous extract against mice's liver damage caused by carbon tetrachloride (CCl4). S.'s protective impact. [7] With about 900 species in the Lamiaceae (previously Labiatae) family, Salvia is a significant genus. Some species of Salvia are grown all over the world for its culinary and traditional medicinal uses. Numerous chemical investigations have been conducted on the genus because of its high level of interest. Diterpenoids, tanshinones, and polyphenols are abundant in it.[8] These substances make up the majority of secondary metabolites and have intriguing biological activity profiles, including cytoprotective, anticancer, and antioxidant properties. antibacterial and as ingredients in herbal teas that have been widely used to treat a variety of conditions, including TB, psoriasis, eczema, neuroasthenic insomnia, hepatitis, hepatocirrhosis, chronic renal failure, dysmenorrhea, flatulence, dyspepsia, gastritis, sore throat, and coronary heart disease and cerebrovascular disease. Three main species of the genus Salvia—S. lanigra Poir, S. splendens Sole, and S. farinacia Benth—represent the flora of Egypt. The purpose of this study was to isolate and clarify the structures of the intriguing components of S. splendens Sello and S. lanigraPoir. Additionally, to screen for antioxidant qualities and cytotoxic activity against specific human cell lines utilizing the inhibition of DPPH technique of various extracts (MeOH, Acetone, and n-butanol) as well as some isolated pure compounds. [9]

Description:

Habitat and geographical distribution:

The Scarlet sage is belonging to Lamiaceae (mint) family native to Brazil that is grown as an annual in North Carolina and India. They grow from 12 to 36 inch high and nearly 12 inches wide. The genus is distributed throughout the world (over 900 total species) with three distinct regions of diversity: Approximately 600 species in Central America and South America, 250 species in central Asia and 90 species in Eastern Asia. [10]

Cultivation:

Scarlet sage, Salvia splendens is a plant originating from Brazil where it is a perennial and is locally used as a medicinal and spice plant. The bell-shaped flowers with a two-lip ped corolla are borne in top inflorescences and grow out from between the bracts from summer till autumn. The specific epithet splendens comes from its splendid and bright red calyces and corollas. Its cultivars are popular and numerous. In the climatic conditions of Poland it is cultivated as an annual plant; its flowering starts at the end of June and continues until the first frosts set in. Flowering starts after around 12 to 14 weeks after sowing. [11]The maximal length of day in which the plants would not come into flower is 7 hours. As a seasonal flower, Salvia splendens has been used in green areas for years. Because of its decorative values and long period of flowering, it is an

attractive and valuable plant used in flowerbeds. Scarlet sage is very frequently used to decorate parks and green areas within cities. It is suitable for borders, rock gardens, and for cultivation in containers. It blossoms richly and is suitable for large area plantations in public areas. It fills empty spaces and is frequently accompanied by other summer flowers. [12] It is very presentable when accompanied by blue lobelia, violet floss flowers or yellow marigold. It is best planted on sandy-clay, fertile soils which are carefully cultivated and moderately humid. The best stand for scarlet sage is a sunny spot, but it also grows in half-shadow. The scarlet sage is a typical flowerbed species and is frequently planted in the company of many other annual plants, differing in their growth characteristics and requirements, with the main criteria for their cho-ice being their decorative values and the final visual effect. [13]

Plant Profile:

Fig: Photographic image of Salvia Splendens Leaves

Plant name: Salvia Splendens

Common Name: Red Salvia, Scarlet Salvia, Scarlet Sage, Vanguard.

Taxonomical position: [14]

Kingdom: Plantae
Class: Endicots
Sub Class: Asterids
Order: Lamiales
Family: Lamiaceae
Genus: Salvia
Species: splendens

Morphological characteristics: [15]

Leaves: Dark to medium green, elliptical, and opposite, with toothed or serrate margins. They can be up to 3–8 long.
Flowers: Scarlet in color, with long tubes and red bracts. They can be up to 2 in long and are produced in dense, erect, terminal racemes. The flowers are two-lipped and bloom from summer to fall.
Stems: Square and upright. Branches: The upper part of the branches are finely hairy and lower parts are hairless.
Cultivars: Many cultivars are available in various shades of red, pink, blue, lavender, orange, white, and bicolor.
Growth: A clump-forming, tender perennial that typically grows to 1–2 feet tall.
Fragrance: The foliage is fragrant when crushed.

Chemical Constituents:

The polyphenolics in Chinese Salvia species are phenolic acids, flavonoids, and anthocyanins, Phenolic acids are one of the main active components.

Phenolic Acids

Caffeic acid and danshensu are the structural units of phenolic acids in Salvia species. Phenolic acids can be classified as caffeic acid monomers, dimers, trimers, tetramers, and multimers based on their polymerization degree. Caffeic acid monomers mainly consist of caffeic acid, danshensu, protocatechuic acid, and protocatechuic aldehyde. Caffeic acid is the basic compound of caffeic acid monomers.[16] Danshensu is also a basic component of caffeic acid derivatives in plant metabolites and the hydrolysate of caffeic acid. Rosmarinic acid and salvianolic acids D, F, and G are caffeic acid dimers. Rosmarinic acid is the simplest caffeic acid dimer, which was first isolated from Rosmarinusofficinalis L. in 1958. It has a high taxonomic significance in Salvia species. Salvianic acid C is synthesized by the condensation of two molecules of caffeic acid. [17-18]

Caffeic acid trimers comprise the following members:

salvianolic acid A, lithospermic acid, and yunnaneic acid C. Structurally, salvianolic acid A has a similar structure to that of salvianolic acid F. It has been speculated that salvianolic acid A is the product of salvianolic acid F and danshensu synthesis. [18] Lithospermic acid is a typical trimer that is broadly distributed in Chinese Salvia species. Caffeic acid tetramers can be regarded as derivatives of rosmarinic acid dimers. They mainly contain salvianolic acid B (typical tetramer), salvianolic acid E, and yunnaneic acid. Salvianolic acid B has potential taxonomic value in Salvia species and represents the main active constituent. [19-20] Presently, three compounds of phenolic acid salts, namely sodium danshensu, magnesium lithospermate B, and ammonium-potassium lithospermate B, have been detected in Salvia species. Magnesium lithospermate B and ammonium-potassium lithospermate B are magnesium and ammonium-potassium compounds of the tetramer salvianolic acid B. Magnesium lithospermate B has antioxidative, anti-liver injury, and anti-myocardial ischemia-reperfusion injury effects. [21-22]

Phytochemical screening of extract:

The various extracts of Salvia splendens were tested for different phytoconsituents like alkaloids, glycosides, saponinins, tannins, terpinoids, phenolic compounds, protein, and carbohydrates using standard procedures. [23] Extract of Salvia splendens (PEESS), ethyl acetate extract of Salvia splendens (EAESS) and methanol extract of Salvia splendens (MESS) roots were detected and compared with ascorbic acid. Total phenolic contents (TPC) The Total phenolic contents (TPC) in petroleum ether extract of Salvia splendens (PEESS), ethyl acetate extract of Salvia splendens (EAESS) and methanol extract of Salvia splendens (MESS) roots were estimated using standard gallic acid equivalent (GAE) of phenols. The concentration of gallic acid (10-50 µg/ml) determined. The total phenolic contents for PEESS, EAESS and MESS were obtained for 1 mg/ml of extracts from total phenolic content calibration of gallic acid. The phenolic compounds are absent in the petroleum ether. The total phenolic content for EAESS and MESS were calculated using standard calibration curve

(y=0.007x+ 0.056, R2 =0.995) and found to have 202.06±0.611and 213.0±0.721 mg/g equivalent of gallic acid respectably. [24]

Total phenolic content (TPC) of different extracts of Salvia splendens.

Extracts	Concentration (mg/ml)	Total Phenolic Content (mg/gGAE)
EAESS	1 mg/ml	202.06±0.611
MESS	1 mg/ml	213.0±0.721

Values are in Mean ±SD for three readings.

Total flavanoid content(TFC) The total flavanoid contents (TFC) in petroleum ether extract of Salvia splendens (PEESS), ethyl acetate extract of Salvia splendens (EAESS) and methanol extract of Salvia splendens (MESS) roots were estimated using standard rutin equivalent of phenols. [25] The total flavanoid contents for PEESS, EAESS and MESS were obtained for 1000 µg/ml of extracts from total flavanoid content calibration of rutin. The phenolic compounds are absent in the petroleum ether. The total flavanoid content for EAESS and MESS were calculated using standard calibration curve (y=0.001x+ 0.120, R2 =0.998) and found to have 92.33±3.055, and 115.33±1.154 mg/g equivalent of rutin respectably. [26]

Total flavonoid content (TFC) of different extracts of Salvia splendens

Extracts	Concentration (mg/ml)	Total Flavanoid Content in mg/g equivalent of rutin
EAESS	1 mg/ml	121.66±3.055
MESS	1 mg/ml	148.66±2.516

Values are in Mean ±SD for three readings.

Pharmacological activity:

CNS Activity: Around the world, salvia has been grown for its culinary and traditional medicinal uses. For instance, the dried root of Salvia has been widely used to treat ulcers, carbuncles, hepatitis, hepatocirrhosis, chronic renal failure, dysmenorrhea, amenorrhea, and coronary and cerebrovascular disease. other species that have significant pharmacological effects. Salvia species' pharmacological effects on the central nervous system will be examined in this review. Hallucinogenic, skeletal muscle relaxant, analgesic, memory-enhancing, anticonvulsant, neuroprotective, antiparkinsonian, sedative and hypnotic, and the prevention of ethanol and morphine withdrawal syndrome are a few of these.[27]

Alzheimer's disease (AD): By blocking the enzyme acetylcholinesterase (AchE) from human brain tissue, the essential oil found in salvia splendens was utilized to treat Alzheimer's disease (AD).

Antitumor Activity: The aqueous and ethanolic extract of salvia on human hepatocellular carcinoma cells and breast cancer cell line models showed the progressive effects in the antiproliferative activity. [28]

Antidiarrheal and antispasmodic activities:

Both in vitro and in vivo experiments were used to investigate the crude extract (aerial) of S. splendens. At doses of 100 and 300 mg/kg, the crude extract prevented mice from experiencing diarrhea brought on by castor oil. It was significantly more effective on low K+, causing a dose-dependent relaxation of spontaneous contractions in isolated rabbit jejunum as well as contractions generated by low K+ (25 mM) and high K+ (80 mM). The inhibitory effect of crude

extract on low K+ was nearly entirely eliminated when tissue was pretreated with 4-aminopyridine (1 mM). These findings suggest that S. splendens' crude extract has antidiarrheal and antispasmodic properties through dominant activation of voltage-dependent K+ channels, and this work offers a solid pharmacological foundation for its potential medical application in the treatment of diarrhea and intestinal spasm. [29]

Wound healing activity: The methanolic extract of Salvia Splendens leaves was examined for its wound healing property in the form of an ointment in two types of wound models in rats; result showed wound contraction ability, epithelization period, tensile strength and regeneration of tissue at wound area. Formulated ointment was topically applied on the infected wound. Wound reduction rate, histological analysis, biochemical analysis, and gelatinzymography were obtained to assess the healing pattern. Salvia Splendens treated rats showed, better wound closure, improved tissue regeneration at the wound site, and supporting histopathological parameters pertaining to wound healing. [30]

Antidiabetic Activity: Streptozocin (STZ)-induced diabetic rats were used to test the antidiabetic effects of the methanolic extract (SSME) and aqueous extract (SSAE) of the aerial portions of Salvia splendens at oral doses of 100 and 200 mg/kg. By lessening the impact of glycemia in rats with STZ-induced diabetes, both extracts had a statistically significant effect when administered orally. These results point to the Salvia splendens extract's strong antihyperglycemic potential in improving diabetic rats' circumstances. The hypoglycemic potential of Salvia splendens leaves was examined. When tested on healthy albino rats, they demonstrated pronounced hypoglycemia action. [31]

Toxicity and anticoagulant Activity: Toxicological Studies carried out on aqueous extract of salvia splendens commonly known as Red sage reveals that the drug is toxic only in higher doses and causes hemorrhages. LD50 of salvia splendens is 1287 mg/Kg. Salvia splendens possesses anticoagulant property. The aqueous root extract of salvia splendens increases the clotting time by 10-15 seconds to 35 seconds. So, the anticoagulant activity depends upon the part of the plant i.e. flowers, aerials and roots [32].

Hepatoprotective Activity: Protective effects of aqueous extract of Salvia splendens against carbon tetrachloride-induced liver injury in mice. Protective effect of Salvia splendens on diethylnitrosamine induced hepatocellular damage and oxidative stress in rats 21. Protective effect of Salvia splendens aqueous extract against carbon tetrachloride (CCl4) -induced hepatic injury in rat. [33]

Antioxidant Activity: Dose-dependent inhibition was generated by the chosen plant extracts and the well-known antioxidant ascorbic acid at different doses. Using 1,1-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity, ferric reducing power activity, hydrogen peroxide (H2O2) scavenging activity, total phenolic content (TPC), and total flavonoid content (TFC), the extracts' in-vitro antioxidant activity was investigated. The gallic acid and rutin calibration curves were used to quantify the total phenolic and flavonoid levels. According to studies on in-vitro antioxidants, every extract has in-vitro However, the activity of the Salvia Splendens leaf extracts were as follows: methanolic > ethyl acetate > petroleum ether. Methanolic extract had the highest levels of total phenolic content (TPC) and total flavonoid content (TFC). We may conclude that extracts from Salvia Splendens leaves have

antioxidant properties, and the strength of these properties varies depending on the type of extract. The strongest antioxidant activity in vitro is seen in the methanolic extract of Salvia Splendens roots. [34]

CONCLUSION:

Review research on *salvia splendes* indicates that these plants have a vast amount of pharmacological potential. Many people firmly believe that comprehensive data on the different pharmacological and phytochemical characteristics of the extracts included in this review can offer comprehensive support for the application of this plant in a range of therapeutic applications. Regional differences exist in the phytochemical variety and therapeutic effectiveness of *salvia splendes*. A large portion of the global population still primarily obtains their medicine from plants today. The task of developing safe, effective, and reasonably priced medications still faces scientists, particularly in rural areas. In vitro, in vivo, and clinical trials are used to quantify these salvia splendes species, as well as to determine the quantity of each phytoconstituent and their pharmacological profiles.

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