

REVIEW ARTICLE**Red sage a Chinese Plant: A Review of Phytochemical and Pharmacological Studies**Abhilasha Mittal^{1*}, Sailesh Narayan²¹Department of Pharmacy, NIMS, Jaipur, Rajasthan, India, ²Department of Pharmacology, Radharaman College of Pharmacy, Bhopal, Madhya Pradesh, India**Received: 15 May 2018; Revised: 15 June 2018; Accepted: 10 June 2018****ABSTRACT**

Salvia splendens Linn. (Family: Lamiaceae), commonly known “Red sage” or “Scarlet sage,” has been used in the different traditional system of medicines for various ailments since ancient times. *S. splendens* grows throughout in Brazil and many other Asian countries such as India and China. This article aims to provide a comprehensive review of the phytochemical and pharmacological aspects of *S. splendens*. In traditional medicine, it has been used in the treatment of dressing of wounds and also applied to itchy skin by the leaves of the plant, roots are mainly used for cold and cough, and seeds are mainly used for emetic, dysentery, hemorrhoids, and colic disorders. It also used for the treatment of diabetes, hematemesis, leukoderma, pruritis, intestinal disorder and as antipyretics, analgesic, and laxative. The fruits, stem roots, and leaves of this plant contain a variety of biologically active compounds such as anthraquinones, flavonoids, flavon-3-ol derivatives, alkaloid, glycosides, tannin, saponin, terpenoids, reducing sugar, and steroids those have various medicinal properties. The leaves stem and roots extract shows various activities such as antipyretic, anti-inflammatory, antioxidant, antidiabetic, hypolipidemic, hepatoprotective, antimicrobial, antitumor, and antiulcer.

Keywords: Antidiabetic, antioxidant, antitumor, cough and cold, dysentery, flavonoids, hepatoprotective, *Salvia splendens*.

INTRODUCTION

Recently, there has been increasing interest in the use of medicinal plants. The plant kingdom has become a target for the search by multinational industries, for synthesizing the drug and biologically active lead compounds. Ethnobotanical information indicates that more than 800 plants are used as traditional remedies for the treatment of many diseases.^[1]

Herbal medicine is currently enjoying a revival in popularity in the west and, of course, the primary form of medicine in many parts of the world. Traditional Chinese, Ayurvedic, and Unani system of medicines are spreading throughout the world with increasing population movement.^[2]

Salvia is wonderful companions in the mixed border, providing the truest blue and brightest red flowers. The red ones, particularly those with long tubular flowers, are ideal and major nectar

sources for hummingbirds as well as many species of butterflies [Figure 1].^[3]

Salvia or *sages* - the two common names are often used interchangeably to refer to the entire *salvia* genus. Both are derived from the Latin word *salvus*, meaning “safe,” “whole,” or “health” - a reference to the healing properties of some species, especially *salvia officinalis*, the common sage.

This blue-flowered *salvia* was a mainstay in medieval gardens and is still grown today in herb and vegetable gardens as a flavoring, medicinal cure-all, and ornamental.^[4] *Salvia species* is reported to have a wide range of biological activities, such as Antibacterial, Fungistatic, Virustatic, Astringent, and Anti-hyrotic effects. On the other hand, there are some reports concerning the hypoglycemic effects, antioxidative properties, wound healing, and anti-inflammatory activity.^[3-6]

Traditionally, the plant is also used as an infusion, decoction, or powder, either alone or in combination with other medicinal plants. In modern times, and in any controlled clinical trials, commercial preparations have tended to be standardized extracts of the whole plant. The

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plant has documented to possess analgesic,^[7] anti-inflammatory,^[8] antioxidant,^[9] antidiabetic,^[10] as well as hepatoprotective activity.^[11]

Since many disease conditions commonly treated with *Salvia splendens* in traditional medical systems are considered self-limiting, its purported benefits need critical evaluation. This review summarizes current scientific findings and suggests areas where further research is needed and also to verify the therapeutic efficacy of *S. splendens*.

Plant description

“Annual” salvia is a tender tropical perennial that is typically grown as a warm weather 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.^[12-15]

Scientific names	<i>Salvia splendens</i>
Common name (s)	Red Salvia, Scarlet Salvia, Scarlet Sage, and Vanguard
Family	Lamiaceae/Labiatae (Mint family)
Plant type	Annual
Height	8 inches to 3 ft
Flowering season	Late spring
Flower color	Red, Purple, and White
Native	Brazil

Taxonomic classification^[3,4,16-18]

Kingdom	<i>Plantae</i>
Class	<i>Eudicots</i>
Sub Class	<i>Asterids</i>
Order	<i>Lamiales</i>
Family	<i>Lamiaceae</i>
Genus	<i>Salvia</i>
Species	<i>splendens</i>

S. splendens is also employed as a remedy for tumors of the abdomen, glands, liver, stomach, and throat, for burns, cancer, constipation, convulsions, delirium, diarrhea, dysuria, epilepsy, gravel, hematuria, pimples, and glandular tumors.^[15-18]

Ayurvedic medicine uses

In Ayurvedic medicine systems, the seeds are attributed with emetics, dysentery, hemorrhoids, and colic disorders while the root is used for cold and cough. The leaves are employed there for the



Figure 1: *Salvia splendens*^[4]

dressing of wounds and also applied to itchy skin. In Brazilian herbal medicine, the seeds are used as an antipsychotic and the leaves, and it is also used for pain and inflammation.^[4]

Pharmacological studies

Antidiabetic activity

The antidiabetic potential of the methanolic extract (SSME) and aqueous extract (SSAE) of the aerial parts of *S. splendens* were studied in streptozocin (STZ)-induced diabetic rats after oral administration at a dose of 100 and 200 mg/kg. On Oral administration, both the extracts showed the statistically significant effect by reducing the effect of glycemia in STZ-induced diabetic rats. These findings suggest the significant antihyperglycemic potential of the *S. splendens* extract in ameliorating the diabetic conditions in diabetic rats. The leaves of *S. splendens* were investigated for their hypoglycemic activity. They were found to have marked hypoglycemic activity on normal albino rats.^[19]

Toxicity and anticoagulant activity

Toxicological studies carried out on aqueous extract of *S. splendens* commonly known as Red sage reveals that the drug is toxic only in higher doses and causes hemorrhages. LD₅₀ of *S. splendens* is 1287 mg/Kg. *S. splendens* possesses anticoagulant property. The aqueous root extract of *S. splendens* increases the clotting time by 10–15 s to 35 s. Hence, the anticoagulant activity depends on the part of the plant, i.e. flowers, aerals, and roots.^[20]

Hepatoprotective activity

Protective effects of aqueous extract of *S. splendens* against carbon tetrachloride (CCl₄)-induced liver injury in mice. Protective effect of *S. splendens*

on diethylnitrosamine induced hepatocellular damage and oxidative stress in rats 21. Protective effect of *S. splendens* aqueous extract against CCl₄-induced hepatic injury in the rat.^[21]

Antioxidant activity

The selected plant extracts and known antioxidant ascorbic acid at various concentrations produced dose-dependent inhibition. The *in vitro* antioxidant activity of the extracts was studied using 1,1-diphenyl-2-picrylhydrazyl radical scavenging activity, ferric reducing power activity, hydrogen peroxide scavenging activity, total phenolic content (TPC), and total flavonoid content (TFC). The TPC and Flavonoid contents were estimated taking Gallic Acid and Rutin calibration curve respectably. In *in vitro* antioxidant studies, it was found that all the extracts possess *in vitro* antioxidant activities. However, the order of possessing activities was Methanolic > Ethyl acetate > petroleum ether extracts of *S. splendens* leaves. The TPC and TFC were highest in the methanolic extract. It can be concluded that *S. splendens* leaves extracts possess antioxidant activities and the potency of antioxidant activities depends on the type of extract. The methanolic extract of *S. splendens* roots possesses the highest antioxidant activity *in vitro*.^[22]

CNS activity

Salvia has been cultivated worldwide for use in folk medicine and culinary purposes. The dried root of Salvia, for example, has been used extensively for the treatment of coronary and cerebrovascular disease, sleep disorders, hepatitis, hepatocirrhosis, chronic renal failure, dysmenorrhea, amenorrhea, carbuncles, and ulcers.

In this review, the pharmacological effects of salvia species on the central nervous system will be reviewed. These include sedative and hypnotic, hallucinogenic, skeletal muscle relaxant, analgesic, memory enhancing, anticonvulsant, neuroprotective and antiparkinsonian activity, as well as the inhibition of ethanol and morphine withdrawal syndrome.^[23]

Treatment of Alzheimer's disease (AD)

The essential oil present in the *S. splendens* was used for the treatment of AD by inhibiting the enzyme acetylcholinesterase from human brain tissue.^[24]

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.^[25]

Antidiarrheal and antispasmodic activities

The crude extract (aerial) of *S. splendens* was studied using the *in vivo* and *in vitro* assays. The crude extract inhibited castor oil induced diarrhea in mice at the dose of 100 and 300 mg/kg. In isolated rabbit jejunum, it caused a dose-dependent (0.1–3 mg/mL) relaxation of spontaneous as well as low K⁺ (25 mM) and high K⁺ (80 mM)-induced contractions, being distinctly more potent on low K⁺. Pretreatment of tissue with 4-aminopyridine (1 mM) almost completely blocked the inhibitory effect of the crude extract on low K⁺. These results indicate that the crude extract of *S. splendens* possesses antidiarrheal and antispasmodic activities mediated possibly through the dominant activation of voltage-dependent K⁺ channels and this study provides the sound pharmacological basis for its medicinal use in diarrhea and gut spasm.^[26]

Wound healing activity

The methanolic extract of *S. 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, epithelialization 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 gelatin zymography were obtained to assess the healing pattern. *S. splendens* treated rats showed, better-wound closure, improved tissue regeneration at the wound site and supporting histopathological parameters pertaining to wound healing.^[27]

CONCLUSIONS

Before the introduction of modern medicines, disease treatment was entirely managed by herbal remedies. It is estimated that about 80% of the world population residing in the vast rural areas of the developing and underdeveloped countries still rely mainly on medicinal plants. It is quite obvious that the plant is widely used in the traditional medicinal

system of India and has been reported to possess hepatoprotective, anti-inflammatory, antifungal and also used to check wounds healing, and antibacterial properties. It is known as a rich source of tannins, flavonoids, and glycosides present in *S. splendens* might be medicinally important and/or nutritionally valuable. Leaf of *S. splendens* mainly contains alkaloids, carbohydrates, glycosides, triterpenoids, flavonoids, etc.

The present review summarizes some important pharmacological studies on *S. splendens* and phytochemical investigations and isolated principles from them, which can be investigated further to achieve lead molecules in search of novel herbal drugs.

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