Indian J. Applied & Pure Bio. Vol. 40(3), 1820-1826 (2025). **ISSN: 0970-2091**
A web of Science Journal

Phytochemical analysis of Sage plant *(Salvia officinalis* L.*)* Leaves

[1]Vijay Wadhai and [2*]Praveenkumar Patre

[1]Department of Microbiology, Sardar Patel Mahavidyalaya, Chandrapur, Gondwana University, Gadchiroli, 442605 (India)
[2*]Department of Microbiology, Mohsinbhai Zaweri Mahavidyalaya, Wadsa Gadchiroli - 442605 (India)
*Corresponding Author Email id-Praveen.patre7@gmail.com

Abstract

The present study investigates the phytochemical composition of *Salvia officinalis* (sage), a medicinal plant widely known for its therapeutic properties. The aim was to identify and quantify key bioactive compounds that contribute to its pharmacological potential. Dried sage leaves were subjected to methanolic extraction, and the resulting crude extract was analysed using standard phytochemical screening methods. The qualitative testing confirmed the presence of various bioactive compounds, including phenols, flavonoids, saponins, alkaloids, tannins, and terpenoids. These results validate the traditional application of sage in herbal remedies and emphasize its promise as a natural source of antioxidants and medicinal compounds. Additional research is suggested to isolate specific constituents and assess their individual biological activities.

Key words : Phytochemical, Medicinal plants, Bioactive.

Salvia officinalis L., often referred to as sage, is a perennial herb with evergreen leaves, belonging to the mint family, *Lamiaceae.* It originally comes from the Mediterranean region and is well known for its use in cooking, its pleasant smell, and its medicinal benefits. Traditionally, sage has been employed in folk medicine for its anti-inflammatory, antimicrobial, antioxidant, and cognitive-enhancing effects. These therapeutic potentials are largely attributed to its diverse array of phytochemicals, including flavonoids, terpenoids, alkaloids, tannins, and phenolic compounds. Sage is commonly used to treat colds due to its anti-inflammatory and antimicrobial properties[11,14].

Over the past few decades, extensive research on sage has focused on its phenolic compounds known for their strong antioxidant activity. Numerous studies have confirmed that sage contains a variety of powerful antioxidants[3,29]. Because of its essential oils and antioxidant constituents, sage has gained

economic importance as a subject of scientific interest. These natural antioxidants from sage may serve as a viable alternative to those found in rosemary, offering potential benefits in preserving food and nutraceutical products by enhancing their shelf life[10,30].

Phytochemicals are bioactive non-nutrient compounds that play vital roles in plant defence and contribute to human health when consumed. The identification and characterization of such compounds in medicinal plants are critical for understanding their pharmacological activities and for developing plant-based therapeutic agents. Given the growing interest in natural products as alternatives to synthetic drugs, the phytochemical profiling of medicinal plants like *Salvia officinalis* has become increasingly important.

This study aims to conduct a qualitative phytochemical analysis of sage plant extract to identify and assess the presence of key secondary metabolites. The outcomes of this work are likely to advance the comprehension of bioactive potentials of *Salvia officinalis*, thereby reinforcing its potential role in the development of pharmaceutical and nutraceutical products.

Harvesting and processing of Plant material:

Fresh *Salvia officinalis* leaves were gathered from Green Heaven a herbal manufacturing unit in Hingna, Nagpur. The freshly picked leaves were meticulously cleaned with distilled water to eliminate any dirt or impurities. They were then left to air dry in a shaded environment (25–30°C) for about seven days. Once completely dried, the leaves were finely ground using an electric grinder. The obtained powder was kept in sealed, airtight containers at ambient temperature until it was required for subsequent analyses.

Extraction Procedure :

Approximately 5 grams of dried sage powder was extracted using a Soxhlet apparatus with 50 mL of 95% ethanol as the solvent over a period of 6 hours. The resulting extract was condensed at 40°C under vacuum conditions employing a rotary evaporation system. Following concentration, it was air-dried to yield a semi-solid crude extract. The crude extract was measured by weight and preserved at refrigeration temperature (4°C) until further phytochemical analysis.

Phytochemical screening :

Phytochemical screenings were performed with extract of sage leaves and primary screening for presence of different secondary metabolites in the leaves extracts were performed and the results were recorded during the present investigation.

Test for Carbohydrates :

Carbohydrate screening involved mixing 2 mL extract with 1 mL Benedict's reagent, followed by 2-minute heating to observe color changes. A positive carbohydrate result was demonstrated by the chromatic change from green to red.

Test for Tannins :

To identify tannins, 1 mL of alcoholic 5% ferric chloride solution and 0.5 mL sulfuric acid were mixed with 1 mL plant extract. The development of a brownish-green hue confirmed tannin content, consistent with established phytochemical methods[2].

Test for Saponins :

Saponin identification was performed by mixing 1 mL plant extract with 2 mL distilled water, followed by 20-minute water bath heating. Persistent foam formation confirmed saponin content[7].

Test for Flavonoids :

Flavonoids were identified by alkaline treatment, where 1 mL extract mixed with 2 mL 10% NaOH solution produced a characteristic yellow color change.

Test for Alkaloids :

Alkaloid identification was carried out by combining 0.5 mL of the plant extract with 1 mL of 1% hydrochloric acid and 1 mL of Wagner's reagent. The presence of alkaloids was confirmed by the formation of a reddish-brown precipitate[9].

Test for Cardiac Glycosides :

The cardiac glycoside assay was performed by combining 1 mL extract with 2 mL glacial acetic acid containing $FeCl_3$ (5%, few drops). Concentrated H_2SO_4 (1 mL) was carefully layered to create an interface, with a brown interfacial ring confirming glycoside presence[23].

Test for Terpenoids :

The terpenoid screening involved sequential addition of chloroform (1 mL) and concentrated H_2SO_4 (2 mL) to plant extract (1 mL). After brief heating (2 min), formation of a gray hue confirmed terpenoid content[27].

Test for Gum and Mucilage :

For gum and mucilage identification, 1 g of dried plant sample was mixed with aqueous-alcoholic solution (1 mL water + 0.2 mL ethanol). The emergence of a sticky or gelatinous consistency was considered indicative of gum and mucilage content in the sample.

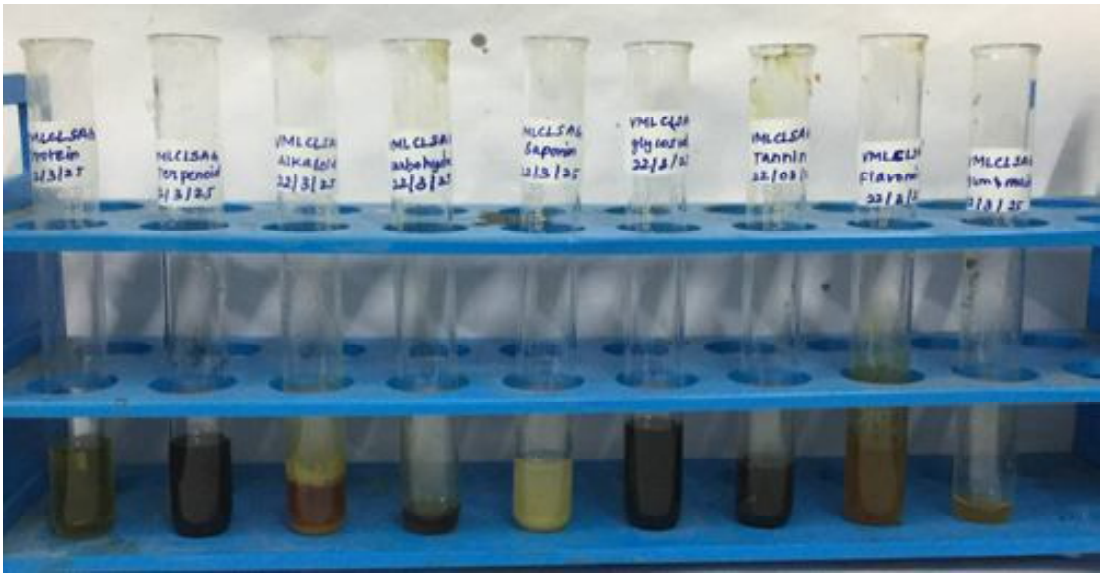

Fig-1. Phytochemical screening of methanolic extract of *Salvia officinalis* (sage) plant

The preliminary phytochemical analysis of *Salvia officinalis* (commonly known as sage) revealed the presence of several bioactive compounds, as shown in Table-1. A strong presence (++) of carbohydrates, tannins, flavonoids, alkaloids, cardiac glycosides, and terpenoids was observed in the methanolic extract of sage, indicating a rich phytochemical profile. However, saponins and proteins were not detected (–) in the sample.

Table-1. Phytochemical constituents of one medicinal plant studied

Sr. No.	Phytochemical Test	Observation (+/-)
1	Carbohydrate	++
2	Tannins	++
3	Saponins	-
4	Flavonoids	++
5	Alkaloids	++
6	Protein	-
7	Cardiac Glycosides	++
8	Terpenoids	++

Note: (++) indicates strong presence; (–) indicates absence.

Qualitative evaluation of Phytochemical constituents :

The ethanol-extracted crude material underwent initial phytochemical analysis using established qualitative methods to detect principal bioactive constituents[28].

The following standard tests were employed for the identification of specific phytochemical groups:

Alkaloid screening : Mayer's and Wagner's reagents produced distinctive precipitates, confirming alkaloid content in the extract.

• Flavonoids were detected using the Shinoda test, in which the appearance of a color change served as an indicator of their presence.

• Tannins were detected through a colorimetric assay using ferric chloride, where a distinct shift to dark green or blue-black confirmed their presence.

• Saponins were confirmed through the frothing test, where the generation of a persistent, stable foam signified a positive result.

• The Salkowski reaction confirmed terpenoid content, with a distinct reddish-brown interfacial layer developing upon testing.

• Phenolic compounds were determined by the appearance of a distinct color change upon interaction with ferric chloride solution.

• Cardiac glycosides were identified using the Keller-Killiani test, in which the formation of a brown ring at the junction of two liquid layers confirmed a positive outcome.

These qualitative tests provide initial insight into the extract's secondary metabolites, forming a basis for future exploration of its bioactive potential.

Each test involved preparing solutions of the extract in appropriate solvents and observing characteristic color changes or precipitate formation indicative of specific compound classes.

The plant extracts were tested and found to contain several natural compounds, some of which are known to support health and have medicinal properties[24]. The screening

identified multiple pharmacologically active compounds such as alkaloids, terpenoids, saponins, tannins, glycosides, flavonoids, and phenolics, each contributing to potential therapeutic effects. Among these, phenolic compounds are abundantly found in plants and are recognized as key natural metabolites contributing to a wide range of biological activities[22]. They are recognized for exhibiting a broad spectrum of positive biological activities, including protection against cell death, aging, and cancer. In addition, they possess anti-inflammatory and cardioprotective effects, support vascular health, and contribute to the inhibition of angiogenesis and abnormal cell proliferation[6]. Numerous investigations have shown that medicinal plants rich in phenolic compounds exhibit significant antioxidant activity. These compounds play a crucial role in protecting biological systems against oxidative stress induced by free radicals[4,12]. Natural antioxidants are primarily derived from plants and are mainly present as phenolic compounds like flavonoids, phenolic acids, and tocopherols[1]. Tannins are known to bind with proline-rich proteins, which can disrupt protein synthesis. Flavonoids are a class of phenolic compounds that contain hydroxyl groups and are synthesized by plants as part of their defense mechanism against microbial infections. These compounds have exhibited antimicrobial effects against various microorganisms in in vitro studies. Their antimicrobial effect is believed to stem from their interaction with extracellular proteins, leading to the disruption of bacterial cell wall structure[13]. Additionally, they function as strong antioxidants and have shown notable potential in anticancer applications[5,17,21].

Saponins were also detected in the plant extracts, and these compounds are well recognized for their anti-inflammatory properties[8]. Saponins can cause red blood cells to clump together and form precipitates. They are characterized by their ability to produce foam when mixed with water, exhibit hemolytic activity, bind to cholesterol, and have a naturally bitter taste[25]. Steroids found in plants are known to possess antibacterial activity and are considered important due to their structural similarity to hormones such as sex hormones[18,20]. Alkaloids, long recognized for their medicinal value, are often noted for their cytotoxic effects[15]. Research has shown that alkaloids may also provide pain relief, reduce muscle spasms, and fight bacterial infections[19,26]. Additionally, glycosides have been widely reported to help in lowering blood pressure[16]. The findings indicate that the detected phytochemicals likely play a key role in the biological activities observed, highlighting the plant's value as a source of therapeutically promising compounds.

The findings highlight medicinally significant phytochemicals in the analyzed plant specimens. Previous research has consistently shown that these phytochemicals possess bioactive properties, contributing to both therapeutic and physiological effects. These natural compounds contribute to the treatment of different health problems and support the traditional use of these plants in folk medicine. Given their potential, these plant extracts can be considered promising candidates for the development of new, effective drugs. It is strongly recommended to preserve and promote traditional healing practices involving these plants. Furthermore, comprehensive

studies are needed to separate, refine, and characterize the individual bioactive constituents responsible for the observed therapeutic effects. Further research is also needed to understand how these extracts work at the molecular level, which could lead to the discovery of novel treatment strategies.

Conflict of Interest
None.

References :

1. Ali, S.S., N. Kasoju, A. Luthra, A. Singh, H. Sharanabasava, A. Sahu, and U. Bora, (2008). *Food Research International*, *41:* pp. 1–15.
2. Ayoola, G.A., H.A.B. Coker, S.A. Adesegun, A. A. Adepoju-Bello, K. Obaweya, E. C. Ezennia, and T.O. Atangbayila, (2008). *Tropical Journal of Pharmaceutical Research*, *7*(3): pp.1019–1024.
3. Bisio, A., G. Romussi, G. Ciarallo, and N. De Tommasi, (1997). *Pharmazie*, *52:* pp. 330–331.
4. Brown, J.E. and C.A. Rice-Evans, (1998). *Free Radical Research*, 29: pp.247–255.
5. Del-Rio, A., B.G. Obdululio, J. Casfillo, F.G. Main, and A. Ortuno, (1997). *Journal of Agricultural and Food Chemistry*, *45:* pp. 4505–4515.
6. Han, X., T. Shen, and H. Lou, (2007). *International Journal of Molecular Sciences*, *8:* pp. 950–988.
7. Harborne, J.B. (1973). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. Chapman and Hall Ltd., London, pp. 49–188.
8. Just, M.J., M.C. Recio, R.M. Giner, M.J. Cuéllar, S. Máñez, A.R. Bilia, and J.L. Ríos, (1998). *Planta Medica*, *64:* pp. 404–407.
9. Kapoor, L.D., A. Singh, S.L. Kapoor, and S.N. Srivastava, (1969). *Lloydia*, *32*(3): pp. 297–302.
10. Kimura, Y. and T. Kanamori, (1982). *US Patent No. 4,363,823*. U.S. Patent and Trademark Office, Washington, DC.
11. Koşar, M., F. Göger, and K.H.C. Başer, (2011). *Food Chemistry*, *129:* pp. 374–379.
12. Krings, U. and R.G. Berger, (2001). *Food Chemistry*, *72:* pp. 223–229.
13. Marjorie, C. (1996). *Clinical Microbiology Reviews*, *12:* pp. 564–582.
14. Monografları, F. (2010). Assessment report on Rosmarinus officinalis L., *aetheroleum and Rosmarinus officinalis* L., *folium*. Tedavide Kullanýlan B, MN Medikal.
15. Nobori, T., K. Miura, D.J. Wu, K. Takabayashi and D.A. Carson, (1994). *Nature*, *368:* pp. 753–756.
16. Nyarko, A.A. and M.E. Addy, (1990). *Phytotherapy Research*, *4*(1): pp. 25–28.
17. Okwu, D.E. (2001). *Pakistan Veterinary Journal*, *14:* pp. 160–162.
18. Okwu, D.E. (2004). *Journal of Sustainable Agriculture and the Environment*, *6*(1): pp. 30–37.
19. Okwu, D.E. and M.E. Okwu, (2004). *Journal of Sustainable Agriculture and the Environment*, *6*(2): pp.140–147.
20. Raquel, F.E. (2007). *Biochimica et Biophysica Acta*, pp. 2500–2509.
21. Salah, N., N.J. Miller, G. Paganga, L. Tijburg, G.P. Bolwell, E. Rice and C. Evans (1995). *Archives of Biochemistry and Biophysics*, *2:* pp. 339–346.
22. Singh, R., S.K. Singh, and S. Arora (2007). *Food and Chemical Toxicology*, *45:* pp. 1216–1223.

23. Smolenski, S.J., H. Silinis, and N.R. Farnsworth, (1969). *Lloydia*, *32*(3): pp. 259–264.
24. Sofowora, A. (1993). *Medicinal Plants and Traditional Medicine in Africa*. Spectrum Books Ltd., Ibadan, Nigeria, pp. 191–289.
25. Sodipo, O.A., J.A. Akiniyi, and J.U. Ogunbamosu, (2000). *Global Journal of Pure and Applied Sciences*, *6:* pp. 83–87.
26. Stray, F. (1998). *The Natural Guide to Medicinal Herbs and Plants*. Tiger Books International, London, pp.12–16.
27. Suresh, P., S. Muthukumarasamy, and S. Ignacimuthu, (2008). *Ethnobotanical Leaflets*, *12:* pp. 1206–1211.
28. Trease, G.E. and W.C. Evans, (1989). *Pharmacognosy* (13th ed.). Baillière Tindall, London.
29. Wang, M., J. Li, M. Rangarajan, Y. Shao, and E.J. LaVoie, *et al*. (1998). *Journal of Agricultural and Food Chemistry*, *46:* pp. 4869–4873.
30. Wellwood, C.R. and R.A. Cole, (2004). *Journal of Agricultural and Food Chemistry*, *52:* pp. 6101–6107.