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Abstract: *The Shami flower is a significant medicinal constituent of a plant (called *Prosopis cineraria*) which is popular in traditional medicine systems, especially Ayurveda. The Shami plant has been used in the treatment of a variety of diseases and is known to be adaptable to arid environments and to be culturally significant to India; some of the diseases that this plant has been used to treat are inflammation, infections, skin disorders, and metabolic disorders. Although the plant has been widely used traditionally, the phytochemical profile and therapeutic properties of the flowers have a relatively low level of exploration. Phytochemical analysis is important in establishing the bioactive compounds of plants that attribute to their medicinal properties. This current review will attempt to give an in-depth summary of the phytochemical constituents found in Shami flower and attempt to relate these constituents with their pharmacological actions. Research has uncovered that Shami flower possesses a large scale of phytochemicals such as flavonoids, tannins, alkaloids, saponins, glycosides, phenolic, terpenoids, and steroids. These are compounds which have been known to have a high biological activity including antioxidant, anti-inflammatory, anti-microbial, anti-diabetic, hepatoprotective, and wound healing. The therapeutic value of these phytochemicals underscores the potential of Shami flower as a rich natural source in the production of new drugs and health-promoting products. Moreover, it finds its applications in pharmaceutical, nutraceutical and cosmetic industries. The need of higher order of analytical research, standardization of extracts and clinical validation to completely prove its efficacy and safety is also highlighted in this review. Altogether, the research summarizes the current information and outlines the gaps in the research, which can be utilized in future studies regarding pharmacological and industrial uses of Shami flower.*

Keywords: *Shami flower, phytochemicals, *Prosopis cineraria*, medicinal plant, bioactive compounds, pharmacological activities*

1: Introduction

1.1 Background of Medicinal Plants in Herbal Medicine

Since ancient times medicinal plants have played a significant role in human healthcare systems, and the traditional medicine of many cultures around the world is based on them. Herbal medicine is based on substances of a plant origin and remains a crucial role in primary healthcare particularly in developing nations. The global health estimates indicate that a considerable percentage of the population relies on remedies of plants owing to their availability, affordability, and perceived safety (Dey et al., 2024). Medicinal plants have been widely used in medicine systems such as Ayurveda, Traditional Chinese Medicine and Unani medicine to prevent and treat diseases. These plants are very diverse in terms of bioactive substances which contribute to the shaping of their medicinal action and can be regarded as a rich source of the new pharmacological research.

The interest in herbal medicine has been revived in recent years following the growing knowledge of the side effects of synthetic drugs (Latif & Nawaz, 2025). Plant-based drugs are seen as safer options, and contain less side effects and are more natural to the human body. Moreover, many of the modern pharmaceuticals are plant-derived, or indirectly, which highlights the considerable role of medicinal plants in the pharmaceutical development and health care systems worldwide.

1.2 Importance of Phytochemical Studies

The study of phytochemicals is important in explaining the chemical make up of medicinal plants and determining the bioactive compounds that cause their therapeutic effect. Phytochemicals are chemical compounds that are naturally found in plants and which have different biological activities, such as antioxidant, anti-inflammatory, antimicrobial and anticancer (Rashid & Shafi, 2018). Scientific research of these compounds makes the researchers to get a scientific base of the traditional use of medicinal plants.

Phytochemical analysis is an important aspect of drug discovery and development because it results in the identification and purification of active compounds. Techniques such as chromatography, spectrophotometry and advanced analysis techniques help in qualitative and quantitative analysis of plant components. These researches help to not only confirm the traditional medicinal practices but also lead to the development of new medications with better efficacy and

safety profiles. Moreover, phytochemical studies facilitate the standardization of herbal preparations, quality assurance, and reduce variability in herbal products.

1.3 Introduction to Shami Plant and Flower

Shami tree, or *Prosopis cineraria*, is an important medicinal shrub that is much more prevalent in arid and semi-arid areas of India. It is in the family “Fabaceae and has been characterized by its outstanding ability to withstand extreme environmental situations like drought and heat. The Shami tree is very ecologically, medicinally, and culturally important, particularly in some states like Rajasthan, Gujarat and South Indian regions.

Flowers of the Shami plant are emerging as an important source of bioactive compounds, but the study of the flowers of the plant is lacking in comparison with the other parts of the plant such as leaves and the bark (Shamili&Santhi, 2017). These flowers have diverse phytochemicals, which make them have therapeutic potential. The different parts of the plant have been used in the past in the treatment of various diseases such as fever, inflammation, skin and digestive issues. It is also the requirement to examine its medicinal activity and the fact that it may be used in pharmacology today that has led to the current trend in the phytochemical study of the Shami flowers.



1.4 Botanical Classification and Taxonomy

The systematic knowledge of the position of *Prosopis cineraria* in the plant kingdom is given by its botanical classification. It is categorized as following:

- Kingdom: Plantae
- Division: Magnoliophyta (Angiosperms)
- Class: Magnoliopsida (Dicotyledons)
- Order: Fabales
- Family: Fabaceae (Leguminosae)
- Genus: *Prosopis*
- Species: *Prosopis cineraria*

This classification classifies the Shami plant in the legume family known to fix nitrogen and have an ecological value. The plant taxonomy plays a significant role in proper identification, classification and comparison with other related species. Knowing its botanical properties help in phytochemical and pharmacological studies as well.

1.5 Research Objectives and Scope

The main aim of this review is to give a detailed analysis of the phytochemical compounds found in the flowers of *Prosopis cineraria* and to analyze their therapeutic potential. The purpose of the review is to summarize and synthesize the current scientific literature regarding the phytochemical composition, extraction procedures, and pharmacological actions in relation to Shami flower.

Besides, the range of the current research covers overview of the traditional applications, contemporary methods of analysis and possible use in pharmaceutical and nutraceutical sectors. Through the fusion of traditional and scientific discoveries, the purpose of this review is to emphasize the significance of Shami flower as a useful source of medicine and to reveal the future research and development opportunities.

2: Botanical Description and Traditional Significance

2.1 Morphology of Shami Plant

The Shami plant (*Prosopis cineraria*) is a small to medium sized evergreen tree that is hardy and able to tolerate arid conditions. It is usually up to 3-10 meters high, rough and dark brown in appearance with a canopy that is spreading out (Upadhyay,2025). The leaves are bipinnate, small and greyish-green in colour, that is why they lose water in dry seasons. Flowers are small, yellowish-green, and grow in thin cylindrical spikes. The flowers are full of nectar and are significant to attracting pollinators. The fruit is a pod that has seeds that are also utilized in traditional medicine and are a source of food in certain areas.

2.2 Geographical Distribution and Habitat

Prosopis cineraria is widespread in arid and semi-arid areas, especially in Indian subcontinent. It is prevalent in Rajasthan, Gujarat, Haryana, Punjab and in some regions of Tamil Nadu. The plant has the ability to grow in sandy soils, and is able to endure extreme weather conditions such as high temperatures, low rainfall and poor soil fertility (Başar&Erenler,2024). It has an extensive root network which enables it to tap underground water and this makes it a significant species to desert ecosystems. The plant is also useful in improving the fertility of soil by fixing nitrogen, which promotes agricultural sustainability in dry areas.

2.3 Ayurvedic and Folk medicine Traditional Uses.

The Shami plant has found extensive application in traditional medicine especially Ayurveda due to its therapeutic effects. Various sections of the plant, such as leaves, bark, pods and even flowers are used in treating various ailments. The flowers have been known to have a potential in treating fever, inflammation, and skin disorders (Kabbash et al., 2021). Plant preparations in the form of decoctions and extracts are applied as remedies in the digestive disorders, respiratory disorders and infections. Its medicinal value is due to the presence of bioactive compounds like flavonoids, tannins and alkaloids. These conventional applications offer a good basis on scientific research on its pharmacological effects.

2.4 Religious and Cultural Importance

The Shami tree is an important religious and cultural tree in India. Hindu tradition regards it as being sacred and being connected to a number of rituals and festivals (Liu et al., 2023). The greatest of these events is the festival of Dussehra, at which is venerated the Shami-tree, as an omen of wealth and success. The Pandavas are said to have concealed their weapons in a Shami tree when they were in exile and so it is regarded as a symbol of power and defense. Leaves of the tree are frequently given out as a gesture of goodwill and good fortune on festive events. This cultural meaning is another way of adding the value of the Shami plant to its medicinal worth.

3: Methodologies Used in Phytochemical Analysis

3.1 Collection and Preparation of Plant Samples

Phytochemical analysis heavily relies on the appropriate collection, and preparation of plant samples. Shami flowers are usually gathered when they are in full bloom so as to get maximum concentration of bioactive compounds (Al Raish et al., 2025). The samples collected are well cleaned to eliminate dust and impurities and then exposed to drying either under shade or under controlled temperature to prevent degradation of sensitive compounds. The samples are dried and then ground to fine particles to enhance the surface area of extraction and kept in airtight containers to preserve their stability until additional analysis is done.

3.2 Extraction Techniques

One of the most significant processes in the isolation of phytochemicals in the plant materials is extraction. Different methods are used which depend on the nature of the compounds and the required yield. One of the most frequently used is solvent extraction, in which the bioactive constituents are dissolved in the solvents, e.g. ethanol, methanol, or water. Soxhlet extraction is a continuous type of extraction, which can be used efficiently to extract compounds by immersing the sample repeatedly into a solvent (Tanwar et al., 2024). Maceration, however, is where the plant material is immersed in a solvent over a long period of time where the compounds are dissolved into the solvent. They have their strengths and weaknesses and the decision on which one to use will depend on the needs of the study.

3.3 Qualitative Phytochemical Screening

The qualitative phytochemical screening entails the determination of the different classes of compounds in the plant extract. The presence of alkaloids, flavonoids, tannins, saponins and other phytochemicals are detected using standard chemical tests. The tests are founded on the color changes or the development of a precipitate in the reaction of the extract with certain reagents. Qualitative analysis gives the initial data concerning the chemical composition of the plant and assists in choosing the methods to be used to conduct the quantitative analysis.

3.4 Quantitative Analysis Techniques

The concentration of phytochemicals in plant extracts can only be quantitatively determined through quantitative analysis (Almeida et al., 2019). This is commonly done through spectrophotometry which quantifies the absorbance of light by the compounds at the different wavelengths. Individual components are also separated and quantified using chromatographic methods i.e. thin-layer chromatography (TLC) and column chromatography. These procedures are precise and reproducible, thus invaluable in the study of phytochemicals.

3.5 Advanced Analytical Methods

Complex analytical methods provide an accurate definition and identification of phytochemicals. High-Performance Liquid Chromatography (HPLC) is popular in the separation of compounds according to their polarity and offers high-resolution data. Gas Chromatography-Mass Spectrometry (GC-MS) is especially applicable to volatile substances, and the determination of their molecular structure (Chaudhary et al., 2018). Fourier Transform Infrared Spectroscopy (FTIR) aids in the determination of the functional groups in the compounds, whereas Nuclear Magnetic Resonance (NMR) spectroscopy assists in obtaining information concerning the structure of the molecule. The methods are important to confirm the chemical composition and therapeutic efficacy of Shami flower extracts.

Table 1: Extraction and Analysis Techniques

Method	Principle	Advantages	Limitations
Soxhlet Extraction	Continuous solvent extraction	Efficient	Time-consuming
HPLC	Separation by polarity	High precision	Expensive

GC-MS	Volatile compound analysis	Accurate identification	Limited to volatile compounds
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4: Major Phytochemical Constituents of Shami Flower

4.1 Alkaloids

The alkaloids are nitrogenous compounds that are characterized by strong biological activity. Alkaloids play a role in a number of pharmacological activities in Shami flowers, such as analgesics and antimicrobials. These substances react with physiological systems and in most cases they act on the central nervous system and have therapeutic effects in controlling infections and pain.

4.2 Flavonoids

Flavonoids refer to a family of polyphenols that are well-known antioxidants. The existence of flavonoids in Shami flowers contributes an important role in the neutralization of free radicals and alleviation of oxidative stress (Yadav et al., 2023). They also have anti-inflammatory, anticancer, and cardioprotective properties, and are required components of plant-based therapeutics.

4.3 Tannins

Tannins are complex phenolic compounds which have strong astringent properties. Tannins in Shami flowers have antimicrobial and wound-healing effects, which involve coating the tissues and preventing the growth of pathogens. They are also believed to prevent oxidative damage and contribute to health.

4.4 Saponins

Saponins are glycosidic substances, which are described by their capacity to create stable foams in solutions with water (Sharma et al., 2024). These substances have anti-inflammatory, immunomodulatory, and antimicrobial effects. Saponin in Shami flowers contributes to the development of immune response in the body and alleviation of inflammation.

4.5 Glycosides

Glycosids are substances which contain a sugar molecule and are bound to a non-sugary molecule. They are renowned by their wide range of pharmacological actions, such as cardioprotective and antimicrobial. The glycosides, present in the Shami flowers, make them have therapeutic potential on the treatment of different diseases.

4.6 Phenolic Compounds

Phenolic compounds play significant roles as antioxidants, which protect cells against oxidative damages. Shami flowers are rich in these compounds, and they lead to their anti-inflammatory and antimicrobial effects. Phenolics also play a role in preventing chronic diseases associated with oxidative stress.

4.7 Terpenoids

Terpenoids are a vast family of natural compounds based on isoprene units. They are known to have a broad spectrum of biological actions such as anti-inflammatory (Awasthi et al., 2024), antiviral and anti-cancer effects. Shami flowers contain terpenoids which play a part in the medical properties and potential medicine use of the plant.

4.8 Steroids

Phytosterols are also referred to as plant steroids that are significant compounds which play numerous roles in the body. Steroids have anti-inflammatory and cholesterol-lowering properties in Shami flowers. They also play a significant role in the sustenance of cell membrane integrity and overall wellbeing.

Table 2: Phytochemicals and Functions

Phytochemical	Chemical Nature	Biological Activity
Flavonoids	Polyphenols	Antioxidant
Tannins	Phenolic polymers	Antimicrobial
Alkaloids	Nitrogen compounds	Analgesic
Saponins	Glycosides	Anti-inflammatory

5: Pharmacological Activities

5.1 Antioxidant Activity

Prosopis cineraria (Shami) flower is mainly credited with its antioxidant properties due to its high flavonoid and phenolic contents. These phytochemicals are important in the neutralization of free radicals and reduction of oxidative stress which is a key factor in chronic diseases like cancer, cardiovascular diseases and aging (Asati et al., 2022). Flavonoids are excellent free radical scavengers because they give hydrogen atoms or electrons thereby stabilizing reactive oxygen

species. Phenolic compounds too elevate antioxidant protection by inhibiting lipid peroxidation, and preventing oxidative damage to cell elements. These compounds are found in Shami flower which indicates that it may be used as a natural source of antioxidant ingredients in therapeutic purposes.

5.2 Anti-inflammatory Activity

Inflammation is a biological reaction to injury or infection but the chronic inflammation may result in a variety of diseases. Shami flower has been found to have high anti-inflammatory qualities that can be attributed to the presence of saponins, flavonoids and terpenoids (Khandelwal et al., 2016). The compounds prevent the synthesis of pro-inflammatory mediators, including cytokines and prostaglandins. Specifically, by regulating the major signaling pathways that are engaged in the process of inflammation, flavonoids alleviate tissue damage and enhance healing. The anti-inflammatory action of Shami flower justifies its traditional use in the treatment of inflammatory diseases including swelling, pain and skin diseases.

5.3 Antimicrobial Activity

The antimicrobial properties of Shami flower can be attributed to its various phytochemical contents which include tannins, alkaloids and phenols. Tannins can also be used as antimicrobials, that is, precipitating proteins in microbes, and destabilizing cell walls, and alkaloids can block the metabolism and multiplication of microbes (Balamurugan et al., 2019). Such compounds have a wide range of action on microorganisms such as bacteria and fungi. The antimicrobial activity of Shami flower is indicative of its possible use in treatment of infectious diseases and in the creation of natural preservatives.

5.4 Antidiabetic Potential

Shami flower is illustrated as promising antidiabetic properties and this could be attributed to the presence of flavonoid and glycosides. These phytochemicals help in keeping the level of blood glucose normal by enhancing the amount of insulin release and absorption of glucose in tissues. They also prevent the action of carbohydrate-digesting enzymes like alpha-amylase and alpha-glucosidase and thus lower postprandial hyperglycemia (Nagori et al., 2025). Antioxidant activity of these compounds is also useful in the protection of pancreatic beta cells against oxidative stress, which also favorably testifies to their application in the treatment of diabetes.

5.5 Hepatoprotective Effects

The hepatoprotective effect of the Shami flower is attributed to the antioxidant and anti-inflammatory phytochemicals of the flower. Phenolic compounds and flavonoids protect the liver cells against the effects of toxins, drugs and oxidative stress. These chemicals increase the action of detoxifying enzymes and minimize lipid peroxidation of hepatic tissues. Shami flower extracts can be used in the prevention of liver disorders and also enhance liver functioning, thus could be useful in hepatoprotective therapy.

5.6 Wound Healing Properties

Shami flower has significant wound healing abilities, due to a combination of tannins, flavonoids, and saponins. Tannins stimulate wound contraction and develop protective coating on the wound, which inhibits the infection of microbes (Peiris et al., 2023). Flavonoids stimulate tissue repair by stimulating collagen synthesis, angiogenesis and saponins have antimicrobial and anti-inflammatory properties that aid in quicker healing. These compounds confirm the conventional application of Shami plant extracts in the healing of wounds and skin damages.



6: Therapeutic and Industrial Applications

The phytochemical abundance of Shami flower renders it a good target in pharmaceutical use. Flower extracts may be used in drug preparations against a wide range of diseases, including inflammatory diseases, infections and metabolic illnesses. Its potential as a natural therapeutic agent is augmented by the existence of bioactive compounds and multiplicity in pharmacological activity (Gupta, 2024). Moreover, the Shami flower based on formulations can be regarded as safer than synthetic drugs, fewer side effects are observed.

Shami flower also has a prospect in the nutraceutical market where products that are produced by plants are used to enhance health and prevent diseases. Its phytochemicals possess the antioxidant

and antidiabetic properties and, therefore, can be incorporated into dietary supplements and functional foods. Frequent use of these products could contribute to the overall health, enhancing immunity, and minimizing the possibility of chronic diseases.

The bioactive components of Shami flower, mainly flavonoids and phenolics, find great application in cosmetic industry. These are anti-aging, antioxidant and skin protecting compounds. They aid in minimizing oxidative stress in the skin cells, preventing early aging and enhance the skin texture. Shami flower extracts can be utilized in making creams, lotions, and other skin care products that target the improvement of the skin health.

The wide range of pharmacological actions of the Shami flower phytochemicals gives them a chance to be drug discovery and development candidates (Sharma et al., 2024). The isolation and characterization of new compounds in the flower can be achieved with the help of advances in phytochemical research and biotechnology. Such compounds are capable of being utilized as lead molecules in developing new drugs with better efficacy and safety. Further investigation in the field might help to find new therapeutic agents that are natural in origin.

7: Challenges and Future Directions

Although there is a promising pharmacological potential of the Shami flower, the available literature is sparse and in most cases, it is not standardized. The use of different extraction methods, sample preparation, and analysis techniques may result in a discrepancy in results. Also, the majority of the research is preliminary and *in vitro* or on animal models, which restricts its relevance to human health.

Lack of clinical trials is one of the greatest problems in the use of Shami flower in contemporary medicine. It is necessary to conduct the scientific validation of the safety, efficacy, and dosage of its phytochemicals using well-designed human study. The therapeutic claims of Shami flower are mostly just theoretical without clinical evidence.

Plant extracts standardization is essential in maintaining uniform quality and efficacy. Nevertheless, the changes in environmental factors, time of harvest, and the processing procedures may influence the phytochemical structure of Shami flower (Akhtar et al., 2022). To address these challenges and assure reproducibility in research and product development, standardized protocols need to be developed to promote extraction and analysis.

Further studies on Shami flower should take place in the form of advanced biotechnological methods and pharmacognostic research. Additional techniques such as metabolomics, molecular docking and bioassay-guided fractionation could provide additional data on its bioactive molecules. In addition, integration of the traditional knowledge and the modern scientific research can enhance the knowledge and application of this plant. Future research has potential to provide promising opportunities due to the exploration of its potential in novel drug development and therapeutic uses.

Conclusion

In conclusion, the phytochemical analysis of Shami flower (*Prosopis cineraria*) reveals the presence of diverse bioactive compounds, including flavonoids, tannins, alkaloids, saponins, and phenolics, which contribute to its wide range of pharmacological activities. These phytochemicals have antioxidant, anti-inflammatory, anti-microbial, anti-diabetic, hepatoprotective and wound healing effects in favour of the traditional application of the plant in the herbal drug.

The increased demand of plant-based therapy products underscores the significance of Shami flower as a source of valuable medicine. Its possible use in pharmaceuticals, nutraceuticals and cosmetic also underline its applicability in contemporary healthcare and industry. However, it is faced by challenges including lack of standardization and clinical validation that must be put in check to achieve the full therapeutic potentials.

All in all, Shami flower is a promising natural source of bioactive compounds that have a great potential in future research and drug development. Further scientific research and validation will open the way to its application in evidence-based medicine and help develop natural product research.

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