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Review Article

Phytochemistry, Traditional Uses, and Medicinal Properties of *Soymida febrifuga* A. Juss: A Comprehensive Review

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ABSTRACT

Soymida febrifuga A. Juss. is a medicinally important tree belonging to the family Meliaceae and has been extensively utilized in Ayurveda, Siddha, Unani, and traditional folk medicine for the treatment of fever, diarrhea, dysentery, malaria, wounds, skin diseases, and inflammatory disorders. The present review summarizes the botanical characteristics, ethnomedicinal applications, phytochemical composition, pharmacological activities, toxicological aspects, and future therapeutic prospects of *S. febrifuga*. Phytochemical investigations have revealed the presence of several bioactive constituents, including flavonoids, alkaloids, tannins, terpenoids, phenolics, limonoids, and tetranortriterpenoids, which contribute to its diverse medicinal properties. Experimental studies have demonstrated significant antimicrobial, antioxidant, anti-inflammatory, antidiabetic, wound-healing, hepatoprotective, and anticancer activities associated with different plant extracts and isolated compounds. The pharmacological potential of the plant is largely attributed to its ability to scavenge free radicals, inhibit microbial growth, regulate inflammatory mediators, and protect tissues from oxidative damage. Despite its promising therapeutic relevance, comprehensive toxicological evaluation, standardization of formulations, and clinical validation remain limited. In addition, overexploitation and habitat degradation have threatened the species in certain regions, emphasizing the importance of conservation and sustainable utilization strategies. Overall, *S. febrifuga* represents a valuable source of natural bioactive compounds with considerable potential for future pharmaceutical and therapeutic applications.

Key words: Antimicrobial activity, Antioxidant activity, Ethnomedicinal uses, Phytochemicals, *Soymida febrifuga*

1. INTRODUCTION

Medicinal plants continue to play a vital role in traditional healthcare systems and modern drug discovery due to their rich diversity of bioactive phytochemicals and broad therapeutic potential. Numerous plant-derived compounds have been recognized for their pharmacological activities, including antimicrobial, antioxidant, anti-inflammatory, anticancer, antidiabetic, and wound-healing properties. In recent years, increasing scientific interest has focused on exploring traditionally used medicinal plants to validate their ethnomedicinal claims and identify novel bioactive compounds for pharmaceutical applications. Among these medicinally important species, *Soymida febrifuga* A. Juss., belonging to the family Meliaceae, has gained considerable attention because of its extensive traditional use and diverse pharmacological properties [1,2].

S. febrifuga, commonly known as Indian red wood, Rohini, Shem, or Mamsarohini, is a monotypic deciduous tree native to the Indian subcontinent and distributed widely across India, Sri Lanka, and Myanmar, particularly in dry and hilly forest regions [3]. The plant has long been utilized in Ayurveda, Siddha, Unani, and folk medicine for the treatment of fever, malaria, dysentery, diarrhea, skin diseases, wounds, inflammation, rheumatic disorders, and gastrointestinal ailments [4-6]. Different parts of the plant, especially the bark, leaves, roots, and seeds, are traditionally valued for their antimicrobial, antipyretic, wound-healing, and anti-inflammatory activities. These traditional therapeutic applications are largely associated with the presence of biologically active secondary metabolites such as flavonoids, alkaloids, tannins, terpenoids, limonoids, phenolics, and tetranortriterpenoids [2].

Phytochemical and pharmacological investigations have demonstrated that *S. febrifuga* possesses significant antibacterial, antifungal, antioxidant, antidiabetic, anti-inflammatory, hepatoprotective, anticancer, and wound-healing activities [7,8]. Bioactive constituents such as methyl angolensate, luteolin-7-O-glucoside, quercetin, and other phenolic compounds contribute substantially to these pharmacological effects through mechanisms involving free radical scavenging, modulation of inflammatory mediators, and inhibition of microbial growth. In addition, the increasing emergence of multidrug-resistant pathogens and chronic inflammatory diseases has intensified the search for safer and more effective plant-based therapeutic agents, thereby enhancing the medicinal relevance of *S. febrifuga* in contemporary research [9,10].

Despite its considerable ethnomedicinal significance and promising biological activities, comprehensive scientific evaluation and clinical validation of *S. febrifuga* remain limited. Furthermore, the species is considered endangered in certain regions due to overexploitation and habitat loss, highlighting the importance of conservation and sustainable

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utilization strategies. Therefore, a detailed review of its traditional uses, phytochemical composition, medicinal properties, toxicological aspects, and future therapeutic prospects is essential for understanding its pharmaceutical potential and promoting further research.

2. BOTANICAL DESCRIPTION, TAXONOMY, DISTRIBUTION, MORPHOLOGY, AND ETHNOMEDICINAL IMPORTANCE

S. febrifuga A. Juss., commonly known as Indian red wood, Rohini, Shem, or Mamsarohini, is a medicinally important deciduous tree belonging to the family Meliaceae. It is a monotypic genus native to the Indian subcontinent and is widely distributed in India, Sri Lanka, and Myanmar, particularly in dry deciduous forests and hilly regions of central and southern India [1]. The tree commonly attains a height of about 20–25 m and is characterized by rough bark, pinnate leaves bearing glossy green leaflets, small creamy-white to yellowish flowers arranged in axillary panicles, and woody capsules containing flattened winged seeds adapted for wind dispersal [2]. The bark and leaves are the most widely utilized parts in traditional medicinal systems.

In Ayurveda, Siddha, Unani, and folk medicine, *S. febrifuga* has traditionally been used for the treatment of fever, diarrhea, dysentery, skin diseases, wounds, rheumatic swellings, and gastrointestinal disorders [4-6]. Bark preparations are particularly valued for their astringent and antipyretic properties and are sometimes regarded as substitutes for Cinchona bark in traditional healthcare practices [4]. Despite its extensive ethnomedicinal relevance, the species is considered endangered in certain regions because of overexploitation and habitat degradation, highlighting the importance of conservation and sustainable utilization strategies [1]. The botanical characteristics, geographic distribution, and medicinally important plant parts of *S. febrifuga* are illustrated in Figure 1.

3. TRADITIONAL AND ETHNOMEDICINAL USES

S. febrifuga has been widely utilized in Ayurveda, Siddha, Unani, and tribal medicine for the treatment of various infectious and inflammatory disorders. Different parts of the plant, particularly the bark, leaves, roots, and seeds, are traditionally used in the management of fever, diarrhea, dysentery, malaria, skin diseases, ulcers, wounds, rheumatic pain, and gastrointestinal ailments [1,4]. The stem bark is considered the most therapeutically important part of the plant and is commonly used as an astringent and antipyretic agent in traditional medicine. Bark decoctions are administered orally for bowel disorders, fever, vaginal infections, and inflammatory conditions, whereas leaf pastes are externally applied for wound healing and skin infections because of their antimicrobial properties [4,6]. In several tribal communities, root and seed preparations are also used for treating malaria, diarrhea, and inflammatory disorders [1].

Traditional preparations of *S. febrifuga* mainly include decoctions, powders, infusions, and topical pastes prepared from different plant parts. The therapeutic importance of the species is largely associated with the presence of flavonoids, tannins, alkaloids, terpenoids, and other phenolic compounds known for antimicrobial and anti-inflammatory activities [11]. Ethnomedicinal knowledge regarding the plant has been preserved among indigenous communities for generations and continues to contribute significantly to rural healthcare systems where access to modern medicine remains limited [4-6]. Although the traditional applications of *S. febrifuga* are well documented, further pharmacological and clinical studies are required to validate its efficacy, establish dosage standards, and support its safe therapeutic utilization [1]. Traditional preparations and therapeutic applications of different parts of *S. febrifuga* are presented in Table 1.

4. PHYTOCHEMICAL COMPOSITION

S. febrifuga possesses a rich phytochemical profile comprising several biologically active secondary metabolites responsible for its medicinal properties. Phytochemical investigations have reported the presence of flavonoids, alkaloids, tannins, phenolics, terpenoids, limonoids, glycosides, saponins, and tetranortriterpenoids in different parts of the plant [2]. Among the identified compounds, methyl angolensate, luteolin-7-O-glucoside, quercetin, and other phenolic constituents are considered pharmacologically important because of their antioxidant, antimicrobial, anti-inflammatory, and cytoprotective activities [6]. Flavonoids and phenolic compounds contribute significantly to free radical scavenging and oxidative stress reduction, whereas tannins are associated with antimicrobial and astringent properties. Similarly,

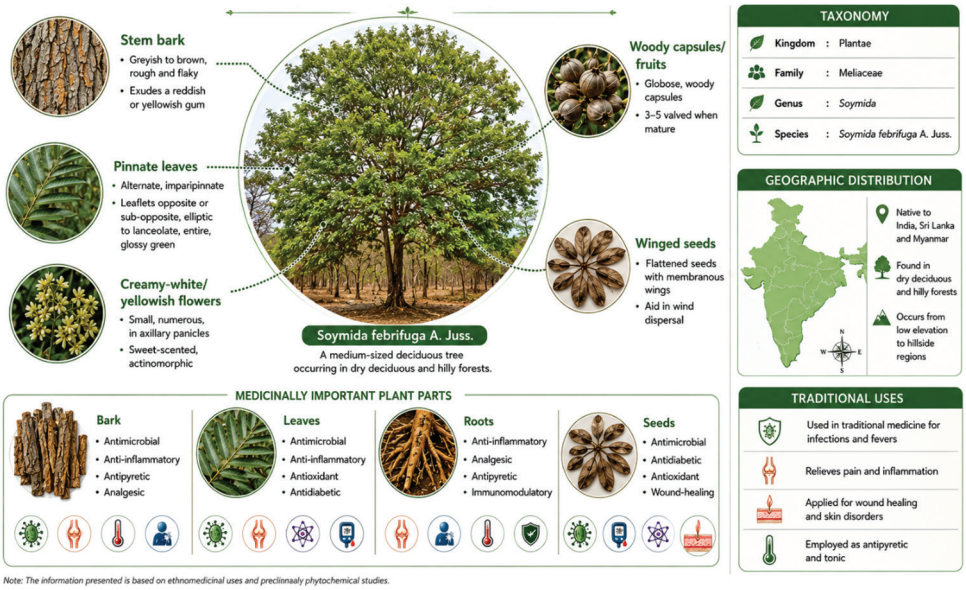

Figure 1: Botanical characteristics and medicinally important parts of *Soymida febrifuga* A. Juss. The figure illustrates the general morphology of the plant, including stem bark, pinnate leaves, flowers, woody capsules, and winged seeds, along with taxonomic classification, geographic distribution, and traditionally medicinally important plant parts used in ethnomedicine.

terpenoids and limonoids exhibit diverse biological activities, including anti-inflammatory and anticancer effects. The diverse phytochemical composition of *S. febrifuga* supports its extensive use in traditional medicine and highlights its potential as a natural source of therapeutic agents. However, further phytochemical characterization and bioactivity-guided studies are necessary to isolate active constituents and better understand their mechanisms of action [4]. The major phytochemicals identified from different parts of *S. febrifuga,* and their associated pharmacological activities are summarized in Table 2.

5. MEDICINAL PROPERTIES

S. febrifuga possesses diverse pharmacological activities that support its extensive use in traditional medicine. Different plant parts have demonstrated significant antimicrobial, antioxidant, anti-inflammatory, antidiabetic, wound-healing, hepatoprotective, and anticancer properties, largely attributed to the presence of flavonoids, tannins, terpenoids, alkaloids, and phenolic compounds [2,6]. These bioactive constituents contribute to multiple therapeutic mechanisms, including free radical scavenging, inhibition of microbial growth, modulation of inflammatory mediators, and tissue protective effects. Owing to its broad spectrum of biological activities, *S. febrifuga* has emerged as a promising source of plant-derived therapeutic agents for the management of infectious and chronic diseases. The major pharmacological activities and possible therapeutic mechanisms of *S. febrifuga* are summarized in Figure 2.

5.1. Antimicrobial Activity

S. febrifuga exhibits significant antibacterial and antifungal activities

Table 1: Traditional preparations, ethnomedicinal uses, and reported therapeutic properties of different parts of *Soymida febrifuga.*

Plant part	Traditional preparation	Traditional uses	Reported therapeutic properties	References
Bark	Decoction, powder	Fever, diarrhea, dysentery, bowel disorders, vaginal infections	Antimicrobial, anti-inflammatory, antipyretic	[4]
Leaves	Paste, extract	Wounds, skin infections, ulcers	Wound-healing, antioxidant, antimicrobial	[5]
Roots	Decoction	Malaria, inflammatory disorders	Antioxidant, anti-inflammatory	[1]
Seeds	Powder, paste	Skin disorders, diarrhea	Antimicrobial	[1]
Stem	Paste, decoction	Rheumatic swellings, joint pain	Anti-inflammatory, analgesic	[4]

Table 2: Major phytochemicals identified in different parts of *Soymida febrifuga* and their reported pharmacological activities.

Plant part	Major phytochemicals	Reported pharmacological activities	References
Stem bark	Flavonoids, tannins, alkaloids, methyl angolensate	Antimicrobial, anti-inflammatory, antipyretic, antioxidant	[4]
Leaves	Phenolics, flavonoids, terpenoids	Antioxidant, antimicrobial, wound-healing	[2]
Roots	Tetranortriterpenoids, alkaloids	Anti-inflammatory, antioxidant	[7]
Seeds	Phenolics, glycosides	Traditional antimalarial and antimicrobial applications	[5]
Whole plant extracts	Flavonoids, tannins, terpenoids, limonoids	Antidiabetic, anticancer, hepatoprotective	[2]

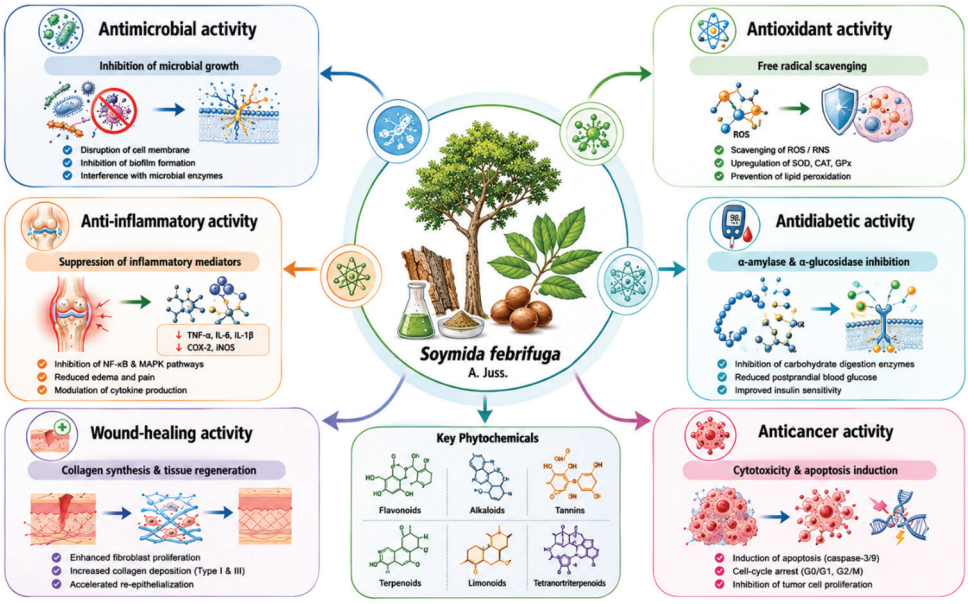

Figure 2: Pharmacological activities and therapeutic mechanisms of *Soymida febrifuga*. The figure summarizes the major biological activities of *S. febrifuga*, including antimicrobial, antioxidant, anti-inflammatory, antidiabetic, wound-healing, and anticancer effects, together with their possible underlying therapeutic mechanisms and major phytochemical classes.

against several pathogenic microorganisms. Extracts from different plant parts have shown inhibitory effects against both Gram-positive and Gram-negative bacteria, including *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus* [8]. Bioactive compounds such as methyl angolensate and luteolin-7-O-glucoside have also demonstrated antimicrobial activity against bacterial and fungal pathogens including *Salmonella typhimurium*, *Aspergillus niger*, and *Alternaria alternata* [9]. These antimicrobial effects are mainly attributed to flavonoids, alkaloids, phenolics, and terpenoids that interfere with microbial cell membranes and metabolic pathways [10].

5.2. Antioxidant Activity

The antioxidant activity of *S. febrifuga* is associated with its high phenolic and flavonoid content. Methanolic and aqueous leaf extracts have demonstrated considerable free radical scavenging activity, particularly against DPPH radicals [9]. Compounds such as quercetin, methyl angolensate, and luteolin-7-O-glucoside contribute to the reduction of oxidative stress by neutralizing reactive oxygen species and preventing cellular damage [11]. These antioxidant properties may support the plant's therapeutic role in inflammatory and degenerative disorders.

5.3. Anti-inflammatory Activity

Several studies have reported the anti-inflammatory potential of *S. febrifuga* bark extracts. Experimental investigations demonstrated significant inhibition of rat paw edema and inflammatory responses comparable to conventional non-steroidal anti-inflammatory drugs [12]. The anti-inflammatory activity is likely mediated through suppression of inflammatory mediators such as nitric oxide and prostaglandins, together with antioxidant mechanisms associated with flavonoids and phenolic compounds [13].

5.4. Antidiabetic Activity

Plant extracts of *S. febrifuga* have shown promising antidiabetic activity through inhibition of carbohydrate-metabolizing enzymes such as α-amylase and α-glucosidase, thereby reducing postprandial glucose levels [14]. Antioxidant-rich phytochemicals may also improve insulin sensitivity and reduce oxidative stress associated with diabetes [2]. Preliminary *in vivo* studies further demonstrated reductions in blood glucose levels in diabetic experimental models.

5.5. Wound-Healing Activity

Conventionally, *S. febrifuga* has been used for the treatment of wounds, ulcers, and skin infections. Its wound-healing potential is associated with antimicrobial, antioxidant, and anti-inflammatory properties that collectively promote tissue repair and regeneration. Flavonoids, tannins, and phenolic compounds help prevent microbial infection, reduce oxidative injury, and support collagen synthesis and tissue remodeling [15]. Tannins additionally promote wound contraction because of their astringent properties.

5.6. Other Pharmacological Activities

In addition to the above activities, *S. febrifuga* has demonstrated anticancer, hepatoprotective, analgesic, antipyretic, and immunomodulatory properties. Tetranortriterpenoids and flavonoids isolated from the plant exhibited cytotoxic activity against cancer cells, suggesting potential anticancer applications [2]. The plant has also shown hepatoprotective effects through antioxidant mechanisms and may contribute to immune regulation and fever reduction [16].

6. TOXICOLOGICAL AND SAFETY ASPECTS

Although *S. febrifuga* possesses considerable therapeutic potential, comprehensive toxicological evaluation remains limited. Phytochemical studies have identified several biologically active compounds, including tetranortriterpenoids, flavonoids, alkaloids, tannins, and phenolic compounds, which are associated with significant pharmacological activities such as anticancer, antioxidant, and anti-inflammatory effects [2]. Certain constituents have also demonstrated cytotoxic activity against cancer cell lines, indicating potential therapeutic relevance in anticancer research. Despite these beneficial properties, the safety of prolonged or excessive use of *S. febrifuga* extracts requires careful evaluation. Variations in extraction methods, dosage, and phytochemical composition may influence biological responses and toxicity profiles. Previous studies on medicinal plants have highlighted possible risks including hepatotoxicity, genotoxicity, and herb–drug interactions associated with improper usage or lack of standardization [17,18]. In addition, contamination with heavy metals, pesticides, or microbial toxins during collection and processing may further affect the safety of herbal preparations. Therefore, detailed acute, subacute, and chronic toxicity studies are essential to establish safe therapeutic dosages and standardized formulations for clinical applications. Further pharmacological and toxicological investigations are also necessary to validate the long-term safety and efficacy of *S. febrifuga* for medicinal use [19,20].

7. FUTURE PERSPECTIVES

S. febrifuga is a medicinally important plant with considerable ethnopharmacological and therapeutic potential. Although several studies have reported its antimicrobial, antioxidant, anti-inflammatory, antidiabetic, and anticancer properties, many traditional claims still require detailed scientific validation [1]. Further investigations focusing on phytochemical isolation, molecular mechanisms, pharmacokinetics, and bioactivity-guided studies are essential to better understand its therapeutic efficacy and pharmaceutical relevance. The development of standardized extraction methods, dosage formulations, and quality control measures is necessary for safe medicinal application. In addition, advanced approaches such as nanotechnology, phytopharmaceutical formulation, and network pharmacology may improve the bioavailability and therapeutic efficiency of bioactive compounds present in *S. febrifuga* [21,22]. Clinical and toxicological studies are also required to establish safety profiles and support future drug development. Since the species is considered endangered in certain regions because of overexploitation and habitat degradation, conservation strategies and sustainable cultivation practices are equally important [23]. Overall, integrating traditional knowledge with modern pharmacological research may facilitate the development of novel plant-based therapeutic agents from *S. febrifuga*.

8. CONCLUSION

S. febrifuga is a therapeutically significant medicinal plant widely utilized in traditional healthcare systems for the treatment of infectious, inflammatory, and metabolic disorders. The plant possesses a diverse range of bioactive phytochemicals, including flavonoids, alkaloids, tannins, terpenoids, and phenolic compounds, which contribute to its antimicrobial, antioxidant, anti-inflammatory, antidiabetic, wound-healing, hepatoprotective, and anticancer activities. Scientific investigations conducted so far support many of its traditional medicinal applications and highlight its potential as a promising source of plant-derived therapeutic agents. However, detailed pharmacological, toxicological, and clinical studies are still required to validate its efficacy, establish safety profiles, and develop standardized formulations for clinical use. Furthermore, conservation and sustainable utilization strategies are necessary because of the endangered status

of the species in certain regions. Overall, *S. febrifuga* represents an important medicinal resource with substantial pharmaceutical potential, and continued interdisciplinary research may facilitate its future application in modern medicine and natural product-based drug development.

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11. ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

Not Applicable.

12. DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing interests that could have appeared to influence the work reported in this paper.

13. DATA AVAILABILITY

Data will be made available on request.

14. DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the author(s) used ChatGPT to improve the language of the manuscript. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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