

Sesbania grandiflora (Hadga/Agati): An Underutilised Medicinal Plant Therapeutic and Nutraceutical Potential for Nutritional Security

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ABSTRACT

Sesbania grandiflora, a member of the Fabaceae family and popularly referred to as Agati or Hadga, is a rapidly growing, versatile leguminous tree indigenous to tropical zones across Africa, Asia, and Australia. Commonly grown in various parts of India especially Maharashtra, West Bengal, and Tamil Nadu it flourishes in humid climates and functions as a conventional "backyard pharmacy". This review compiles contemporary scientific insights into the tree's diverse phytochemical constitution, which contains an abundance of saponins, alkaloids, tannins, flavonoids, and specific isoflavonoids like medicarpin and isovestitol. The presence of these bioactive molecules offers scientific justification for its wide-ranging pharmacological properties, encompassing antioxidant, antidiabetic, hepatoprotective, anticancer, and neuroprotective activities. Nutritional assessments confirm that the leaves and flowers are highly concentrated in protein, calcium, iron, potassium and vitamins A, B9 and C, showcasing a strong potential to strengthen global nutritional security. Current studies also underscore its growing importance as a nutraceutical option for managing diabetes mellitus by inhibiting digestive enzymes, as well as a natural remedy for migraines and anaemia owing to its analgesic, anti-inflammatory, and haemoglobin-restoring actions. This thorough review establishes *Sesbania grandiflora* as a therapeutic "gold mine," accentuating the vital need for methodical research and commercial value addition to transform this neglected asset into a pivotal factor for worldwide health and economic well-being.

Keywords: Agastya, Antidiabetic, Bioactive compounds, Ethnomedicine, Phytochemicals

1. INTRODUCTION

The genus *Sesbania* comprises approximately 60 species distributed globally across Africa, Asia and Australia. Among these *Sesbania grandiflora*, a member of the Fabaceae family, is widely recognized as a significant traditional medicinal plant in Asia used to alleviate symptoms of various diseases (Kashyap S, Mishra, 2012). Commonly referred to as the hummingbird, flamingo, or butterfly tree this species is also known by synonyms such as Sesban

grandiflora, Agati *grandiflora* and *Coronilla grandiflora*. Historically revered as Hadga or Agati, it serves as a cornerstone remedy within Ayurveda, Unani and Siddha medicine systems for a wide array of ailments. While its leaves have been integrated into ethnomedicine since antiquity (Padal et al., 2014), all parts of the plant including roots, seeds, and leaves possess therapeutic value. Modern phytochemical investigations on extracts from these various parts continue to provide scientific validation for its traditional properties.

<https://doi.org/10.5281/zenodo.21530158>

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NG Agriculture Insights, 2(S1), 2026

Since antiquity, *Sesbania grandiflora*, widely known by its local names Hadga or Agati, has been a pillar of traditional medical systems, particularly Ayurveda, Unani, and Siddha. Recognized as a therapeutic "gold mine," it is utilized to treat a broad range of ailments, including epilepsy, smallpox, jaundice, and colic disorders. In various folk medicine traditions across Asia, it is also extensively employed to alleviate symptoms of chronic illnesses and microbial infections.

The traditional therapeutic applications of this species are highly specific to each plant part:

- **Leaves:** Utilized to treat nasal catarrh and night blindness (nyctalopia), as well as serving as an iron supplement to manage anemia.
- **Flowers:** Administered for cough and bronchitis, and utilized as a natural laxative.
- **Bark:** Acts as an astringent to address mouth ulcers and infantile stomach disorders.
- **Roots:** Prepared and applied as a poultice to alleviate rheumatic swelling.

Beyond its medicinal use, the plant also has great dietary and social significance. The large white flowers, called Bok phool, of West Bengal are a traditional culinary delicacy that is usually dipped in batter and fried. In states like Maharashtra and Tamil Nadu, it is often grown as a "backyard pharmacy" to have instant access to its healing properties. *S. grandiflora* is also culturally and agriculturally important as a sacred tree in local rituals and as "green manure" because it can fix atmospheric nitrogen and improve soil fertility. *Sesbania grandiflora* is an underutilised species in the Indian landscape, due to the absence of commercial supply chains and the critical safety distinction between its varieties; the white-flowered variety is a safe culinary staple, while the purple variety is highly toxic. The lack of standardisation of doses further hinders its inclusion in conventional medicine. Also, there is a global trend in healthcare to use synthetic drugs instead of plant-based nutraceuticals. There is a need for systematic research and value-added product development to move this from a "backyard pharmacy" to a mainstream health resource, capable of demonstrating its safety and economic proposition over the long term. The article attempts to evaluate the synergy between the nutritional profile and therapeutic uses.

2. NUTRITIONAL COMPOSITION (NUTRACEUTICAL POTENTIAL) OF *SESBANIA GRANDIFLORA* (HADGA/AGATI)

Sesbania grandiflora (Hadga/Agati) is an efficacious nutraceutical source, the leaves, flowers

and fruits of which serve as dense repositories of macro and micronutrients. Its nutritional composition is good for vital biological processes and provides a natural alternative to managing health and treating chronic diseases.

2.1 Nutritional Density and Proximate Value

- **Vitamins:** It is enriched with significant amounts of Vitamin A (Carotenoids), Vitamin C, Riboflavin (B2), and Nicotinic acid (Niacin).
- **Minerals:** The plant is a rich source of Zinc, Selenium, Calcium (1,130 mg/100g), Phosphorus (80 mg/100g), and Iron (3.9 mg/100g).
- **Macronutrients:** The leaves provide approximately 93 mg of energy and 8.4 g of protein per 100g, while the flowers contain novel protein fractions (SGF60 and SGF90) with chemopreventive properties.
- **Dietary Use:** All aerial parts are edible and integrated into traditional dishes like Agathi keera (South India) and Bok phool (West Bengal).

2.2 Phytochemical and Nutraceutical Profile

- **Secondary Metabolites:** The plant is a "gold mine" of alkaloids, flavonoids, saponins, tannins, steroids, and terpenoids.
- **Specialized Constituents:** Roots contain unique isoflavonoids like isovestitol, medicarpin, and sativan, while leaves provide essential amino acids such as arginine, cysteine, and phenylalanine.

2.3 Therapeutic-Nutritional Synergy

- **Metabolic & Hematological Health:** Synergistic action between flavonoids and minerals helps reduce blood glucose, cholesterol, and LDL, while leaf powder serves as an iron and folate supplement to improve hemoglobin levels in anemic patients.
- **Disease Management:** The high concentration of nutrients exerts anti-inflammatory, analgesic, and antiviral effects.
- **Organ Protection:** Antioxidant status is restored through increased levels of superoxide dismutase and catalase, protecting the heart, liver, and kidneys from oxidative damage.

3. PROCESSING AND VALUE ADDITION

Processing and value addition are critical to transitioning *Sesbania grandiflora* from a seasonal "backyard pharmacy" to a standardized, year-round nutraceutical resource. Given its rapid perishability, various methods are employed to enhance its shelf life and concentrate its bioactive potential.

3.1 Culinary Processing and Domestic Use

Traditional methods focus on making the plant palatable while reducing potential anti-nutritional factors:

- **Traditional Delicacies:** In West Bengal, the flowers (Bok phool) are dipped in batter and fried, which is a common method to include this medicinal plant in the daily diet.
- **Use as Vegetable:** The leaves, fruits and flowers are used as vegetables in curries and salads.
- **Flower preparation:** The flowers are important ingredient for the traditional South Indian dish Agathi keerai.
- **Toxicity Management:** It is very important in processing that only the white flowered variety is selected as the purple flowered variety is very toxic and cannot be used for consumption.

3.2 Drying and Powder Formulation

Dehydration is the most common method for creating stable, value-added products:

- **Leaf Powder Production:** Leaves are dried and ground into a fine powder to be used as a concentrated iron and folate supplement.
- **Hemoglobin Restoration:** This powdered form has been clinically shown to improve hemoglobin levels in individuals suffering from mild to moderate anemia.
- **Nutrient Retention:** Drying processes are designed to preserve the high levels of Vitamin A (carotenoids), Vitamin C, and Riboflavin found in the fresh biomass.

3.3 Advanced Pharmacological Value Addition

Modern pharmaceutical research focuses on extracting specific active ingredients for targeted therapy:

- **Novel Protein Isolation:** Researchers have isolated specific protein fractions (e.g. SGF 60 and SGF 90) from the flowers which are processed for their significant inhibitory effect on digestive enzymes related to diabetes.
- **Nanotechnology Integration:** The use of leaf extracts in the "green synthesis" of Silver Nanoparticles (AgNPs) is on the rise. These synthesised particles are found to have strong antibacterial activity against multidrug resistant (MDR) bacteria like *Staphylococcus aureus*.
- **Standardised extracts:** Ethanol and methanol extraction methods are used to concentrate isoflavonoids (isovestitol, medicarpin, sativan) and betulinic acid, which are used in anticancer and anti-tuberculosis medications.

3.4 Industrial Value Addition

Beyond human health, the plant is processed for various industrial applications:

- **Paper and Pulp Industry:** The softwood of *S. grandiflora* serves as a major source of pulp for high-quality paper making.
- **Green Manure:** The plant's ability to fix atmospheric nitrogen enables it to be used as "green manure," which significantly improves soil fertility for other crops.
- **Energy and Construction:** The wood is processed for use as fuel, charcoal, and poles for construction or fishing nets.

3.5 Medicinal Uses

- **Leaves:** Used for treating thrombosis, diarrhea, inflammatory diseases, bronchitis, cough, wounds, ulcers, dysentery, nasal catarrh, nyctalopia, and cephalalgia (Fig. I).
- **Flowers:** Known for antimicrobial, anti-inflammatory, analgesic, and antipyretic effects. They also show potential in killing leukemic cells and developing anti-plaque toothpaste and mouthwash. The white flowers are non-toxic and commonly used in Bengali cuisine, often fried in batter. They are rich in vitamins and minerals (Fig. II & III).
- **Roots:** Used externally for rheumatic swelling and contain compounds with anti-tuberculosis properties.



Figure 1. *Sesbania grandiflora* Leaves



Figure 2. *Sesbania grandiflora* White Flower

- **Bark:** Acts as an astringent and bitter tonic, used for treating inflammation, smallpox, ulcers, and scabies.

- **Fruits:** Beneficial for anemia, bronchitis, fever, tumors, and intellectual stimulation.



Figure 3. *Sesbania grandiflora* Purple Flower

4. ROLE IN NUTRITIONAL SECURITY

Sesbania grandiflora is recognized as an underutilized resource with great potential to improve global nutritional security because of its abundant nutrient composition and rapid growth. It's a therapeutic "gold mine" especially for populations in tropical areas.

4.1. Combatting Malnutrition

- **Integration into Rural Diets:** The leaves, fruits, and flowers are all edible and can be consumed on their own as vegetables or added to traditional curries and salads.
- **Micronutrient Density:** The plant is a rich source of Vitamin A (carotenoids), Vitamin C, Riboflavin, and Nicotinic acid, which are essential for biological functions.
- **Mineral Support:** It provides high levels of Calcium (1,130 mg), Iron (3.9 mg), Zinc, and Selenium, helping to reduce cellular damage and support the immune system.
- **Anemia Management:** The use of leaf powder as an iron and folate supplement has clinically demonstrated improvement in hemoglobin levels for those with mild to moderate anemia.
- **School Midday Meal Potential:** Given its high protein content (8.4g in leaves) and essential amino acids like cysteine and isoleucine, it is an ideal candidate for fortification in school meal programs.

4.2. Economic Viability

- **Low-Cost Cultivation:** *S. grandiflora* is a fast-growing tree, capable of reaching 4–5 meters in height in just six months, ensuring a high yield with minimal investment.
- **"Backyard Pharmacy":** Frequently planted near homes in India, it provides rural families with immediate, free access to its diverse medicinal and nutritional benefits.
- **Value-Added Products:** Systematic research into standardized healthcare products and raw material collection can transition this traditional plant into a mainstream economic contributor.
- **Multi-Purpose Wood:** Beyond food, the wood is utilized as poles, fuel, charcoal, and as a major source of paper pulp, providing secondary income streams.

4.3. Sustainable Agriculture

- **Nitrogen-Fixing Properties:** As a leguminous tree, it can fix atmospheric nitrogen, which naturally enriches the soil.
- **Green Manure:** It is utilized as green manure to improve soil health and conditions for surrounding crops.
- **Environmental Protection:** The tree's structure allows it to be effectively planted as a windbreak or shade tree in large-scale plantations.
- **Rapid Adaptation:** Its ability to grow in various environments in Africa, Australia, and Asia makes it a resilient choice for sustainable farming systems.

5. CONCLUSION

The diverse research on *Sesbania grandiflora* (Hadga/Agati) confirms its status as a highly versatile gold mine of medicinal and nutritional potential. It is one of the pillars of Ayurveda and Unani systems that provides pharmacological remedies for a wide spectrum of diseases like diabetes, anaemia, microbial infections to tumours. This underutilised leguminous tree helps to address hidden hunger, while also being a dense source of protein, vitamins A, C and B9, and essential minerals such as iron and calcium. Besides its medicinal properties, the plant enriches the soil by nitrogen fixation and provides raw materials for the paper, fuel and charcoal industries. In practice, its inclusion in the diet of the rural population and the

school midday meal scheme can be a potent weapon against malnutrition. For this backyard pharmacy to become a mainstream resource, systematic research must focus on the clinical validation of optimal dosages and environmental adaptation. Ultimately, production of value-added products is essential for global health and nutrition security.

The multifaceted research conducted on *Sesbania grandiflora* (Hadga/Agati) strongly establishes it as a highly versatile underutilised "gold mine" of therapeutic and nutritional potential. A hardy leguminous tree, a key component of traditional Ayurvedic and Unani medicine for centuries, provides potent, scientifically proven pharmacological solutions for a broad range of health disorders. The special biochemical profile provides strong antidiabetic interventions through flower derived protein fractions (SGF60 and SGF90) inhibiting major digestive enzymes. Structural extracts of this plant exhibit tremendous activity against microbes, tuberculosis and cancer. Also, the plant is being actively studied as a natural option for migraine treatment and chronic pain relief due to its profound analgesic and anti-inflammatory pathways.

Simultaneously, *Sesbania grandiflora* is a very dense and low cost source of macro and micro nutrients, addressing a critical global challenge of hidden hunger. The fresh leaf biomass includes an impressive 8.4 g/100 g of crude protein rich in essential amino acids such as arginine, cysteine and phenylalanine alongside substantial levels of vital vitamins A, C and B9. It also contains a good mineral support of 1,130 mg/100 g of calcium and 3.9 mg/100 g of iron. When made into a fine, dried leaf powder, it is a powerful iron and folate supplement that has been shown to restore haemoglobin levels in patients with mild to moderate nutritional anaemia to a clinically significant extent. The secondary metabolites such as flavonoids and saponins provide the high antioxidant status of the plant, which also helps to protect the vital organs such as heart, liver and kidneys from progressive oxidative damage. In addition to its therapeutic and dietary direct uses, the tree is a very sustainable contribution to agricultural ecosystems and rural economies. It is a fast-growing legume that can reach five meters in six months and is very efficient at fixing atmospheric nitrogen, making it a perfect "green manure" that naturally improves soil fertility and reduces the need for synthetic chemical fertilisers. Its structural versatility makes it an effective agroforestry windbreak, and its softwood furnishes reliable raw materials for the paper pulp, fuel, and charcoal industries, thereby creating important secondary income streams for local farmers. In practice, large-scale inclusion of its non-

toxic white flowers and leaves in household rural diets, and their strategic fortification in the state-sponsored school midday meal scheme can go a long way in curbing childhood protein energy malnutrition and hidden hunger.

However, to move *Sesbania grandiflora* from a local backyard pharmacy to a mainstream standardised health care resource, significant commercial and scientific bottlenecks need to be addressed. Future systematic research should include rigorous human clinical trials to validate optimal standardised dosages and map environmental adaptations across different tropical climates. Strict protocols for culinary processing must also be reinforced to ensure the safe use of the white-flowered phenotype, as the purple-flowered variant is highly toxic. Finally, the systematic development of value-added consumer products from antidiabetic supplements to anti-plaque oral care formulations are essential for the full economic viability of this ecological treasure and long-term global health and nutritional security.

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