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A Comprehensive Review on the Therapeutic Potential of Wild Sugarcane (*Saccharum spontaneum* Linn.)

Shanmuga Deepika V[1]*, Ruth V[2], Adithya V[3], Srimathi V[4], Dr. Padma R[5], Dr. Sathish A[6]

[1,2,3,4] Undergraduate Research Scholar, GRD College of Pharmacy, Thiruvallur, India.
[5]HOD, Dept. of Pharmacognosy, GRD College of Pharmacy, Thiruvallur, India.
[6]Principal, GRD College of Pharmacy, Thiruvallur, India.
Affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai. India.

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ABSTRACT

Saccharum spontaneum L., commonly known as Kasa and belonging to the Poaceae family, is a perennial grass native to tropical Asia with extensive traditional medicinal uses. It addresses various ailments such as burning sensations, obesity, dyspepsia, mental illness, urinary tract infections, and reproductive and respiratory issues. In Ayurveda, it functions as an astringent, emollient, diuretic, purgative, tonic, and aphrodisiac. The Siddha system also utilizes Kasa for mental disorders, abdominal issues, dyspnoea, anaemia, and obesity. Phytochemical studies demonstrate its richness in quinones, alkaloids, saponins, tannins, carbohydrates, proteins, coumarin, phenols, steroids, terpenoids, and glycosides. This review details the plant's chemical composition, safety, traditional applications, and pharmacological effects. Modern pharmacological research validates these claims, notably its anti-urolithiatic activity, diuretic, antioxidant, anti-inflammatory, antimicrobial, and CNS modulatory effects observed in various studies. The review highlights the comprehensive evidence supporting Kasa's use in managing renal calculi and inflammatory conditions, advocating for further clinical studies to explore its potential in standardized phytopharmaceutical development.

Keywords: Kasa, *Saccharum spontaneum,* Anti-urolithiatic, Ayurveda, Quinones

INTRODUCTION

Saccharum spontaneum, commonly known as Kasa or wasteland weed, is a tall perennial grass from the Poaceae family. Found throughout tropical Asia, including India, and in regions such as tropical Australia and parts of America and Africa, it can reach heights of up to 4 meters. Often considered a significant weed, it spreads widely due to its rhizomes and deep roots, leading to abandonment of infested fields. *S. spontaneum* is thought to be an ancestor of cultivated sugarcane (*S. officinarum* L.) and can reproduce both sexually and asexually, thriving in various environments. Leaves and stalks contain lignin, proteins, carbohydrates, and amino acids. Roots and root stocks contain starch and polyphenolic chemicals. Blood disorders, biliousness, hemorrhagic diathesis, burning feelings, strangury, phthisis, and vesical calculi might all benefit from aerial parts. Additionally, they have aphrodisiac and laxative properties. The stems can help with dyspepsia, hemorrhoids, menorrhagia, dysentery, agalactia, phthisis, and general debility. [1, 2]

Saccharum spontaneum is recognized by Ayurveda as an essential medicinal herb that is used to cure a number of ailments, such as dyspepsia, burning sensations, piles, and respiratory problems. Its roots have astringent, purgative, and aphrodisiac qualities. While fresh juice from its stems is used in Indian tribal rituals to treat mental health difficulties, the entire plant helps with stuttering, blood diseases, and other maladies. The Philippines has also reported using it medicinally. [3]

The species' culm is mostly used to make pulp, particularly for the creation of grease-proof paper. Local communities use leaves for thatching as well as for making a variety of crafts such ropes, mats, baskets, and brooms. These leaves are good for making silage and can be fed to young goats and camels. They work well as mulch because of their sluggish pace of breakdown. The species *S. spontaneum* L. has a high carbohydrate content (67.85% based on dry solids), making it an excellent substrate for ethanol production. In contrast to other fibers like hemp, cotton, jute, flax, and ramie, this biomass grows quickly and has blooms that are high in fiber. To improve the strength, fineness, and resilience of *S. spontaneum* fibers to chemicals, moisture, and heat, advances in morphological alterations, such as chemical treatments with methyl methacrylate, have been investigated. [4-6]

It has excellent rooting capacities, rapid early growth, substantial morphological heterogeneity, and resistance to a variety of biotic and abiotic stresses. With a base chromosomal number of x = 8 and a chromosome variation ranging from 2n = 40 to 128, it is described as a multicytotype, complicated polyploid. *S. spontaneum* originated in India and is currently found all over the world, from Japan and New Guinea to the Mediterranean and Africa. It has recently been widely used as a donor to create high biomass energy canes with higher fiber content and higher yields. [7, 8]

BOTANICAL PROFILE

Taxonomy and Nomenclature

Saccharum spontaneum is a grass species belonging to the family Poaceae. Its formal classification was established by Carl Linnaeus, and it is part of the genus Saccharum, which includes cultivated sugarcane. The binomial name *Saccharum spontaneum* L., published in 1771, has led to confusion due to its various synonyms in botanical literature, such as *Imperata spontanea* and *Saccharum chinense*. Its common names include Wild Sugarcane and Kans Grass, while in Sanskrit, it is referred to by names that highlight its characteristics, like Kasha and Kshugandha. [9, 10]

Table 1: Vernacular Names and Synonyms of *Saccharum spontaneum* [11]

Scientific Name	*Saccharum spontaneum* L.
Botanically Similar Plants	*Imperata spontanea, Saccharum aegyptiacum, Saccharum canaliculatum*
Common English Names	Wild Sugarcane, Kans Grass, Thatch Grass, Tiger Grass
Vernacular Names	Kash, Kansh (Bengali); Kas, Kasa, Kaans (Hindi); Naanal, Peykkarumbu (Tamil); Kadu kabbu (Kannada); Nannana, Kusa (Malayalam); Talahib, Tigbau -Tagalog, Bisaya (Philippines); Tian gen zi cao (Chinese); Gelagah (Indonesian);

Morphology

Saccharum spontaneum is a robust, erect, perennial grass forming dense clumps. It has a deep, spreading rhizomatous root system contributing to its hardiness. The slender, fibrous culms can reach heights of 1 to 4 meters, turning brown or black as they mature. Leaves are long, linear-lanceolate with a prominent pale white midrib, serrated and prickly margins. Inflorescence features large, terminal, branching panicles (20-60 cm) with dense, feathery spikelet's and silky white hairs. The fruit is a tufted caryopsis, approximately 1.5 mm, aiding in wind dispersal. [8, 12]

Fig 1: *Saccharum spontaneum* Linn. [13]

Geographical Distribution

Saccharum spontaneum, native to the tropical and subtropical regions of the Old World, spans parts of Africa, Southern Europe, the Middle East, and Asia up to Northern Australia. Believed to have evolved in India's sub-Himalayan valleys, it exhibits remarkable ecological adaptability, thriving in moist habitats like riverbanks and marshes but also tolerating drier conditions in grasslands and deserts. This resilience enables it to colonize various soil types, including infertile alluvial and saline soils. [14]

In certain areas, it is classified as an aggressive weedor invasive species due to the same persistence and quick, strong growth that make it a significant medical resource. It has expanded widely, outcompeting native flora and creating thick, pure stands in places like the Panama Canal Watershed, especially in regions that have been cleared by floods or human activity. This dual character as an ecological challenge and a medicinal herb offers a special chance. Its rapid growth, low nutritional requirements, and high biomass production—the very traits that characterize its invasiveness—also make it a very sustainable and accessible raw material source. A bio-economic strategy, in which this invasive biomass is methodically and sustainably gathered for the manufacturing of phytopharmaceuticals, might be used in place of expensive eradication procedures. In line with contemporary ideas of sustainable development and ethnopharmacology, this would turn an ecological issue into a useful resource for healing. [15]

PHYTOCHEMISTRY

Secondary metabolites found in *Saccharum spontaneum* root extracts can be discovered by phytochemical analysis of various extracts, showing the plant's phytochemical content. The S. root extract. Strong antioxidant and free radical scavenging properties are displayed by spontaneum. Numerous phytoconstituents, including glycosides, phenolic components, alkaloids, flavonoids, tannins, steroids, and terpenoids, may be responsible for this. The results of the study suggest that S. spontaneum root may be a useful natural antioxidant source that might be employed as a medicinal agent to prolong life, prevent disease, and maintain good health. [16]

Quinones, terpenes, alkaloids, phenolic compounds, coumarins, saponins, tannins, steroids, proteins, and carbohydrates are some of the important phytoconstituents found in S. spontaneum leaves. This species' quick growth and low cost make it a suitable feedstock for the generation of fuel ethanol in the future. Its stem's high carbohydrate content (67.9% by weight) indicates that it is suitable for ethanol bioconversion, mainly through cellulose and hemicellulose. Investigating new lignocellulosic biomass (LB) feedstocks has become common procedure as biomass energy becomes more significant. Often referred to as wild sugarcane, kans, or sarkanda, *S. spontaneum* is a perennial rhizomatous grass belonging to the Poaceaceae family that has the capacity to produce ethanol. [17]

It generates about 80 tons of biomass per hectare in tropical locations, such as Pakistan, Bangladesh, India, Nepal, and Sri Lanka. It grows on marginal ground and requires less water, while being less important commercially. It is a feasible renewable feedstock for ethanol-biofuel due to its 70% carbohydrate content, lignin (26%), extractives (6.14%), and ash (3.3%). The specific application of Ionic Liquids (ILs) in combination with surfactants for SSB pretreatment has not yet been investigated, despite research on the bioconversion of sodium bromide utilizing a variety of pretreatments. [18, 19]

Table 2: List of Secondary Metabolites in *Saccharum spontaneum* Linn. [20-22]

Secondary Metabolite	Plant Part	Therapeutics Activity
Quinones	Leaves, Stem	Antimicrobial, Laxative
Phenolic Compounds	Roots, Leaves	Antioxidant, Anti-inflammatory, Antimicrobial
Terpenes	Roots, Leaves	Anti-inflammatory, Antimicrobial, Cytotoxic
Coumarins	Roots, Leaves, Stem	Anti-inflammatory, Anticoagulant, Antimicrobial
Steroids	Roots, Leaves, Stem	Anti-inflammatory, Hormonal activity
Alkaloids	Roots, Leaves, Stem	CNS active, Analgesic, Antimicrobial
Saponins	Roots, Leaves	Anti-inflammatory, Immunomodulatory, Hypocholesterolemic
Glycosides	Roots, Stem	Cardiotonic, Diuretic, CNS active
Essential Oils	Roots	Aromatic, Antimicrobial

TRADITIONAL APPLICATION

The term "ethnobotany" refers to the study of local populations' interactions with their surroundings with the goal of recording customary plant uses that represent cultural knowledge. In order to incorporate traditional knowledge into resource management and promote biodiversity and cultural respect, ethnobotanical studies place a high priority on working with local communities. One important plant in this regard is *S. spontaneum*, which is used in traditional Indian medicine and is particularly well-known for its root qualities, which include diuretic and purgative actions. Its leaves are used to make a variety of goods, and its shoots are used for food in the Philippines and Indonesia, according to local customs. The plant's economic significance and multipurpose use are further demonstrated by the fact that it is an important resource for papermaking and animal feed. [23, 24]

S. spontaneum has long been used for a variety of therapeutic uses by tribal communities in Andhra Pradesh and Tamil Nadu. The stems of the plant are used to treat ailments like hemorrhoids, menorrhagia, dysentery, and mental disorders. The roots work as a galactagogue and diuretic to treat UTIs. The plant's leaves are known for its cathartic and diuretic qualities, and its aerial portions exhibit laxative and aphrodisiac qualities. In Ayurvedic and Siddha traditions, the entire herb is used to cure obesity, gynecological problems, and stomach illnesses because to its purgative, tonic, and astringent properties. [25, 26]

Applying leaf paste to injuries to stop pus from forming, using stem juice to cure mental diseases, and chewing fresh stems to relieve stomachaches are some of the specific uses that have been suggested. Because of the plant's many uses, its fibers are often weaved into everyday objects like grain containers and carpets. Studies on the plant's effectiveness as a diuretic and for gastrointestinal and gynecological problems have been prompted by reports highlighting the community's trust in the plant's positive effects. As a result, *S. spontaneum* is acknowledged for its wide range of therapeutic uses among indigenous communities, helping to treat a variety of illnesses and fulfilling useful purposes in day-to-day living.

Table 3: Traditional uses of different plant parts of *Saccharum spontaneum* L.

Plant part	Uses
Aerial parts	Anemia, dyspnea, vomiting, mental illnesses, stomach problems, and fatness. [27]
Leaves	Building ropes, baskets, mats, brooms, and houses. Camels and goats' food. Pullas (a traditional mat) and brooms. [28]
Roots	Used for galactagogue, and diuretic urinary tract infections. [29]
Culm	A reliable source of pulp for making various grades of paper, particularly greaseproof paper. [28]
Whole Plant	Contain carbohydrates, an appropriate substrate for the synthesis of ethanol. [29]

PHARMACOLOGICAL ACTIVITIES

Anti-urolithiasis activity

In line with its Ayurvedic classification as a Mutravirechaniya (diuretic) herb, specifically recommended for Ashmari (renal calculi), *S. spontaneum*'s medicinal action is clearly validated for its effects on the urinary system. The ethanolic root extract of Kasha demonstrated notable anti-urolithiatic effects at doses of 200 and 300 mg/kg in meticulously carried out *in-vivo* investigations, especially in rat models of induced urolithiasis. In addition to regulating important lysosomal enzymes like xanthine oxidase and β-D-glucuronidase that contribute to stone etiology, the extract successfully restored aberrant levels of urinary stone-forming ingredients such calcium, oxalate, urea, and uric acid. Its effectiveness was comparable to that of thiazide, a common diuretic and anti-urolithiatic medication, demonstrating its promise for kidney stone treatment and prevention. According to the research, the word Ashmarihara (stone remover) refers to both specific impacts on stone formation mechanisms and enhanced urine flow, supporting ancient Ayurvedic assertions. The extract's historical effectiveness in treating Ashmari is confirmed by its capacity to regulate hyperoxaluria and hypercalciuria, the biochemical indicators that cause crystal formation. [30, 31]

Anti-oxidant activity

Numerous *in vitro* investigations show that S is capable of scavenging free radical *S. spontaneum* extracts using phosphomolybdenum, FRAP (Ferric Reducing Antioxidant Power), and DPPH (2,2-diphenyl-1-picrylhydrazyl) tests. Root and whole plant ethanolic extracts have moderate to significant antioxidant effects; one study found that the overall antioxidant activity was 488 µg/ml, which is similar to ascorbic acid's 410 µg/ml. Due to the high concentrations of phenolic and flavonoid chemicals in the extracts, a recent methanolic extract of the flowers also shown potent antioxidant activity. [32]

Anti-inflammatory activity

It has been shown to have anti-inflammatory properties *in vivo*. A significant study assessed a cream made with 0.5% to 2% ethanolic root extract in a mouse model of paw edema caused by carrageenan. The outcomes were striking: the 2% extract cream significantly reduced inflammation, and after three hours of application, its efficacy outperformed that of Diclofenac 1% gel, a common anti-inflammatory medication. Another study found that *Saccharum munja*, a similar species, had mild anti-inflammatory properties against edema caused by carrageenin.[5]

Anti-microbial Activity

Herbs are commonly used in traditional medical systems to cure illnesses; studies have shown that *S. spontaneum* has broad-spectrum antibacterial qualities. Significant antibacterial activities against a variety of human pathogenic bacteria were found in an *in vitro* investigation of a methanolic extract from the entire plant. Gram-positive strains like *Staphylococcus aureus* (17.00 mm) and *Streptococcus pneumoniae* (16.50 mm) as well as Gram-negative germs like *Escherichia coli* (18.00 mm) and *Klebsiella pneumoniae* (17.10 mm) showed significant zones of inhibition against the extract. For both Gram-positive and Gram-negative bacteria, the minimum inhibitory concentration (MIC) varied between 75 and 300 µg/ml and 75 and 600 µg/ml, respectively. Phytochemicals like tannins and flavonoids, which can interfere with vital bacterial functions including cell wall and protein synthesis, are responsible for this antibacterial effect. Furthermore, leaf extracts based on ethanol shown antibacterial efficacy against *Bacillus subtilis*. [33, 34]

CNS depressant activity

In a study on rats, Vhuiyan et al. evaluated the effects of aqueous, ethanolic, and chloroform extracts on locomotor activity at a dosage of 1000 mg/kg (p.o.). They discovered that all extracts reduced movement, suggesting a central nervous system (CNS) depressive action. Furthermore, a different study shown that methanol extract dramatically reduced locomotor activity in both hole cross and open field tests, with a higher CNS depressive effect seen at a dose of 400 mg/kg as opposed to 200 mg/kg. [35]

Safety and Toxicology

When assessing the therapeutic index of novel medications or herbal extracts, preclinical safety evaluations are crucial. Studies on *S. spontaneum's* ethanolic root extract show a large safety margin. Over the course of a 14-day observation period, increasing doses up to 2000 mg/kg were given to Wistar albino rats in an acute toxicity trial without any mortality or toxicity indications. This suggests that the median lethal dose surpasses 2000 mg/kg, classifying it as practically non-toxic. Furthermore, a 28-day sub-acute toxicity study at dosages between 100 and 500 mg/kg showed no negative effects on body weight or notable changes in biochemical parameters linked to electrolytes and kidney function, indicating that long-term administration at therapeutic levels carries little risk of organ damage or systemic toxicity. In line with the plant's traditional use, where poisonous plants would have been recognized and avoided over generations, this strong preclinical safety profile provides the scientific foundation for moving on to human clinical trials. [36]

CONCLUSION

Saccharum spontaneum, sometimes referred to as wasteland weed or wild sugarcane, is a multipurpose plant with many traditional therapeutic uses, especially in South Asia, and a rich phytochemistry. Because of its many medicinal qualities, which include antioxidant, antiurolithiasis, anti-obesity, CNS depressant, antibacterial, antifungal, cytotoxic, anti-inflammatory, anti-diarrheal, and hypolipidemic effects, it treats a wide range of illnesses, including gastrointestinal and mental health disorders. Its phytoconstituents—alkaloids, flavonoids, tannins, and terpenoids—are responsible for these advantages. Furthermore, *S. spontaneum* is a viable sustainable biomass feedstock for fuel ethanol production due to its high carbohydrate content and quick growth. Beyond the medical field, it is used in businesses such as mulching, papermaking, and rope and mat manufacturing. Its promise as a therapeutic agent is supported by safety assessments that show low toxicity.

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