A comprehensive review of *Saccharum spontaneum*, its traditional uses, phytochemistry and pharmacology

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Review

Abstract

Background: Saccharum spontaneum belongs to the Poaceae family. It is also known as kans grass or wild sugarcane. It is a perennial grass that can grow up to 4 meters tall with deep roots and rhizomes. Higher morphological variability, early vigour, the ability to root, and resistance to a range of biotic and abiotic stressors are characteristics of this wild species. Tropical regions of the world such as tropical Australia and the tropical nations of Asia, Africa, and America are home to this plant. when plants are at juvenile stages camels and goats eat it. Quinones, Terpenes, Alkaloids, Phenolic Compounds, Coumarins, Saponins, Tannins, Steroids, proteins, and Carbohydrates are among the phytoconstituents present in leaves. This herb treats respiratory problems, gynaecological problems, burning pain, piles, and dyspepsia.

Aims of the study: To aware all the people about *Saccharum spontaneum* and its valuable traditional and medicinal uses and also about the presence of phytochemical constituents and their role in different fields.

Materials and methods: Google Scholar, PubChem, and Open Access Library were used to locate references about *Saccahrum spontaneum* between 1998 and 2024.

Conclusion: Saccharum spontaneum has bright futures ahead of it, including potential uses in complementary and alternative medicine and drug development. To identify and isolate the main bioactive compounds and to elucidate the precise mechanisms underlying their pharmacological actions, more research is required. Furthermore, investigating its production and sustainable harvesting methods may result in the creation of cutting-edge medications or nutraceuticals.

Keywords: *Saccharum spontaneum,* Traditional, Phytochemistry, Pharmacology.

Background

The Poaceae family includes *Saccharum spontaneum*, a tall, upright perennial grass that resembles reeds and is known locally as Kasa. It is found throughout tropical Asia (Parrotta, 2001) and India (Kirtikar & Basu, 2005). *Saccharum spontaneum* is a native of South Asia (India) (Devi & Kameswari; Govindaraj *et al.*, 2016; Karthigeyan *et al.*, 2020). It is widespread in tropical Australia and the tropical nations of America, Africa, Asia, Pakistan, Bangladesh, Sri Lanka, India, and Nepal as some nations where it is frequently grown (Saltonstall *et al.*, 2021).

Saccharum spontaneum, commonly known as wasteland weed, is a tall perennial grass with rhizomes and deep roots that can reach heights up to 4 meters. According to (Xu *et al.*, 2019) it is thought to have been an ancestor of the significant species *S. officinarum L.*, which is known as cultivated sugarcane. Its global distribution spans three geographical zones: the

East, Central, and West zones, as well as other nations. Millions of acres are infested, and fields are frequently abandoned as a result (Govindaraj *et al.*, 2016). Among the Saccharum species, *S. spontaneum* has the greatest distribution. The species may reproduce both sexually and asexually and it has established itself in several different environments (J. A. da Silva, 2017).

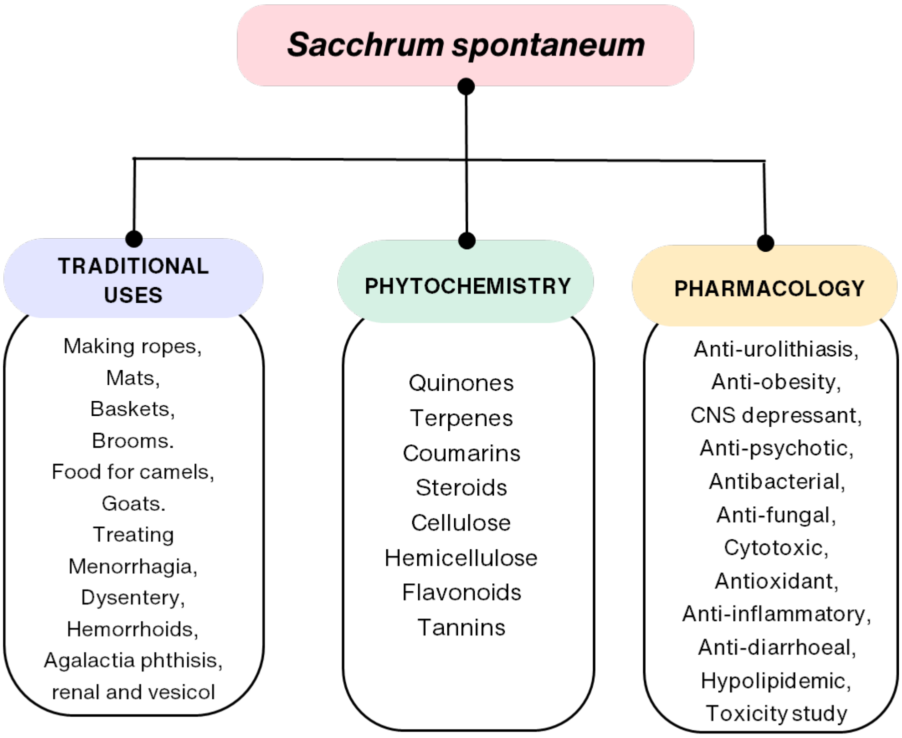


Figure 1. Uses of *Saccharum spontaneum*

Lignin, carbohydrates, proteins, and amino acids are found in leaves and stalks (J. J. Da Silva *et al.*, 2023; Llerena *et al.*, 2019). Starch and polyphenolic compounds are found in roots and root-stocks. Aerial parts are beneficial for blood diseases, biliousness, hemorrhagic diathesis, burning sensations, strangury, phthisis, and vesical calculi. They also have laxative and aphrodisiac qualities (Saiffullah, 2022). Dyspepsia, hemorrhoids, menorrhagia, dysentery, agalactia, phthisis, and general debility can all benefit from the stems (Devi & Kameswari).

According to Ayurveda, one of the key therapeutic herbs in India's traditional medical systems is *Saccharum spontaneum.* Many conditions are treated with the plant's roots, such as dyspepsia, burning sensations, piles, sexual weakness, gynecological issues, and respiratory issues. In addition, they have aphrodisiac, purgative, lithotriptic, emollient, refrigerant, sweet, and astringent properties (Kumar *et al.*, 2010). The whole plant is beneficial for stuttering, phthisis, burning feelings, calculi, hemorrhage, diathesis, biliousness, and blood disorders (Saiffullah, 2022). Many Indian tribes also employ the fresh juice of plant stems to treat mental health conditions and difficulties. There have been many documented medical applications in the Philippines (Lapuz *et al.*, 2016).

The culm of the species is a valuable source of pulp used to make different grades of paper, particularly grease-proof paper. To support their way of life, the locals use leaves to make ropes, mats, baskets, brooms, and other items. Leaves also make good thatching material. According to Singh *et al.* (2014), it can be fed to goats and camels as a juvenile and is appropriate for making silage (Shaheen *et al.*, 2020). It's a great material for mulching because of its slow rate of decomposition (D. Maiti & Pandey, 2021).

S. spontaneum L. is a special and superior substrate for the synthesis of ethanol because of the high carbohydrate content (67.85% when based on dry solids) in its cell walls (Chandel *et al.*, 2011; Scordia *et al.*, 2010). It is a biomass that proliferates and has fibre-containing flowers (Xiong *et al.*, 2023). The appearance of these fibers differs greatly from that of other types including hemp, cotton, jute, flax, and ramie (M. Maiti *et al.*, 2011). Better strength and fineness are characteristics of these white/purplish silky fibers examined the morphological changes brought about by chemically modifying *S. spontaneum* fibers through graft copolymerization with methyl methacrylate to increase their resistance to chemicals, moisture, and heat (Kaith *et al.*, 2009; Kaith & Sharma).

The wild species *Saccharum spontaneum* is characterized by greater morphological variability, early vigor, rooting ability, and resistance to a range of biotic and abiotic stressors (Saltonstall *et al.*, 2021). It is a multicytotype, complex polyploid. With a base chromosomal number of x = 8, its chromosome number varies from 2n = 40–128 (Meng *et al.*, 2020). It is believed to have come from India (Mary *et al.*, 2006). However, it is found throughout the world ranging from New Guinea and Japan to the Mediterranean and Africa (Aitken *et al.*, 2018). To create high biomass energy canes with high yield and high fiber content, *S. spontaneum* has been widely utilized as a donor in recent years (Burner & Legendre, 2000; Mirajkar *et al.*, 2019).

Figure 2. Pictures of *Saccharum spontaneum*

Materials and methods

Google Scholar, PubChem, and Open Access Library were used to locate references about *Saccahrum spontaneum* between 1998 and 2024.

Results

Trditional uses

In situations of hemorrhoids, menorrhagia diarrhea, agalactia phthisis, renal and vesical calculi dyspepsia, and general debility, the stems (culm) can be beneficial. *Saccharum spontaneum* stem juice for the treatment of mental disease and mental disorders (Kumar *et al.*, 2010).

The roots have aphrodisiac, tonic, diuretic, lithotriptic, emollient, sweet, astringent, emollient, and refrigerant properties (Moovendan, 2013). Additionally, they help with burning sensations, piles, dyspepsia, gynecological difficulties, sexual weakness, and respiratory concerns (Kumar *et al.*, 2010).

S. spontaneum's rapid growth and lack of need for financial assistance make it one of the most promising biomass feedstocks for the generation of fuel ethanol in the future (Chandel *et al.*, 2009). It was originally believed that *S. spontaneum*, a tall, perennial grass having rhizomes and deep roots, is a wasteland weed (Pandey *et al.*, 2015). The plant has a maximum height of 6 meters (Pandey *et al.*, 2015). It spreads like a weed over millions of acres of farmland (Chandel *et al.*, 2009; Tai & Miller, 2001). With a high percentage of carbohydrates (67.9% by weight), the plant stem and sheath of *S. spontaneum* may be a suitable substrate for the bioconversion of fuel ethanol (Scordia *et al.*, 2010).

The root extract of *S. spontaneum* exhibits strong free radical scavenging and antioxidant activities. This could be caused by a variety of phytoconstituents including steroids, alkaloids, tannins, glycosides, flavonoids phenolic components, and terpenoids (Sathya & Kokilavani, 2013). Natural antioxidants found in roots may prove to be a great source of medicinal agents for promoting health, preventing illness, and lengthening life (Moovendan, 2013).

It is a perennial grass that grows to a height of 3 to 4 meters (Bonnett *et al.*, 2014). It can be found in Malaya, Polynesia, Southern China, and India (Moore *et al.*, 2013). Proteins, carbohydrates, saponins, tannins, phenol, Quinone, terpenoids, alkaloids, coumarin, and glycosides are abundant in this plant (Devi & Kameswari; Sathya & Kokilavani, 2013). It has been utilized in the past to cure numerous ailments, such as burning sensations, mental disease, urinary tract infections, obesity, dyspepsia, sexual weakness, and gynecological, and respiratory problems (Meena *et al.*, 2009).

Tall (100–600 cm), tufted, and rhizomatous perennial grass *S. spontaneum* has a spreading rootstock. Serect, polished, robust stem measuring 100 × 0.4–400 × 1.5 cm, with the solid upper part and fistular lower part, solid internodes, and 5–10 waxy nodes. With a rounded base and long hairs, the leaves are involute, linear-lanceolate, and have a membranous, ciliolate ligule that is 2-4 mm long. It bears fruit and flowers from June to September (Pandey *et al.*, 2015).

Table 1. Vernacular names of *Saccharum spontaneum* (Hussain *et al.*, 2014).

Language	Vern. name
Bengali	Kans
Hindi	Kasa
Odia	Kasatandi
English	Thatch grass
Assamese	Khagor
Bengali	Kans

Traditional uses

The term "ethnobotany" refers to a broad category of research that describes how locals interact with their natural environment (Eldeen *et al.*, 2016). Ethnobotany offers an appropriate method for recording and preserving the knowledge of traditional plant uses that have been gathered by a community over many generations in connection with their culture (Subedi & Dani). The goal of ethnobotanical study is to better understand the characteristics of traditional knowledge and work with the local community to set priorities. This way, local values can be effectively translated into resource management decisions that respect biological variety and cultural knowledge (Ibrar *et al.*, 2007). According to Ayurveda, one of the main therapeutic herbs used in traditional Indian medical systems is *S. spontaneum*. Many Indian tribes also use the fresh juice of plant stems for medicinal purposes. Many medical applications have been documented in the Philippines. The plant's roots have the following qualities: they are purgative, tonic, diuretic, lithotriptic, emollient, sweet, and aphrodisiac (Mohammad & Siddiqui, 2011). Additionally, they are applied to treat piles, burning sensations, gynecological disorders, dyspepsia, and sexual weakness (Kumar *et al.*, 2010). The young shoots are boiled and eaten with rice in Indonesia (Mulu *et al.*, 2020). This species' culm provides an abundant supply of pulp for papermaking especially grease-proof paper, in different grades. To support their way of life, the locals use leaves to make ropes, mats, baskets, brooms, and other items. Leaves also make good thatching material. It's reportedly fed to camels and goats in the juvenile stage (Shaheen *et al.*, 2020). It's a great material for mulching because of its slow rate of decomposition (D. Maiti & Pandey, 2021). Ropes, pulllas (a traditional mat), and brooms are made from mature leaves, which also contain a minor portion of culms (Singh *et al.*, 2014). *S. spontaneum L.* is unique in that it has high amounts of carbohydrates (6.785% on a dry solid basis) in its cell walls (Chandel *et al.*, 2011; Scordia *et al.*, 2010).

Tribal people in Andhra Pradesh and Tamilnadu have long used *S. spontaneum* to treat a variety of conditions including obesity, vesicles calculi, burning sensations, biliousness, galactagogue, and strangulation (Ghani, 1998; Kirtikar & Basu, 2005; Mall *et al.*, 2022). The stems are used to treat menorrhagia dysentery, hemorrhoids, agalactia phthisis, renal and vesicol calculi dyspepsia, burning sensation, mental illness, and mental disturbances (Sureshkumar *et al.*, 2009). Roots are used to treat urinary tract infections and as a diuretic and galactagogue (Lapuz *et al.*, 2016). Laxative and aphrodisiac qualities are present in aerial parts (Devi & Muthu, 2015). This herb has purgative, tonic, diuretic, astringent, emollient, and aphrodisiac properties, sexual weakness, burning sensation, piles, gynecological problems, vomiting, mental conditions, abdominal disorders, dyspnea, anemia, and obesity in the Ayurvedic and Siddha systems (Hussain *et al.*, 2014). Leaves are used for cathartic and diuretic action. (Khalid *et al.*, 2011; Kodali & Banu, 2016). Flag leaf sheaths are used to produce fiber for household usage. For household use, tender leaves are woven into mats, rugs, and grain receptacles. To make a broom, inflorescence axes are securely tagged at their thicker, lower sub-terminal ends. To prevent pus development from forming in cuts and wounds, apply the leaf paste of this plant (Suman & Singh, 2023). The stem juice of *Saccharum spontaneum* is used for mental illness and disturbances (Kodali & Banu, 2016). *S. spontaneum* serves as fuel for fires, which flare up quickly and rekindle after a fire (Bhatta *et al.*, 2022). The root extract of this plant has been used to treat urinary tract infections because some people who practice traditional medicine in rural regions consider it to have a diuretic effect. Chewing on freshly prepared, chopped stems can help ease stomach aches (Lapuz *et al.*, 2016). The reports that the plant has beneficial properties and that a small number of our locals have utilised the root extract as a diuretic and galactagogue for gastrointestinal and gynecological issues led to the investigation of the root extract of *S. spontaneum* (Lapuz *et al.*, 2016). The portions of the aerial parts used to treat illnesses including anemia, dyspnea, vomiting, mental illnesses, stomach problems, and fatness. The fresh juice of the *S. spontaneum* plant's stem is used by the rural populace to heal mental disorders and disturbances (Rajkumar *et al.*). The entire plant is used to treat anemia, obesity, dyspnea, mental illnesses, vomiting, and stomach ailments. For the treatment of dyspepsia, burning feelings, piles, sexual weakness, gynecological issues, respiratory issues, etc., roots are helpful (Padalia & Chanda, 2015).

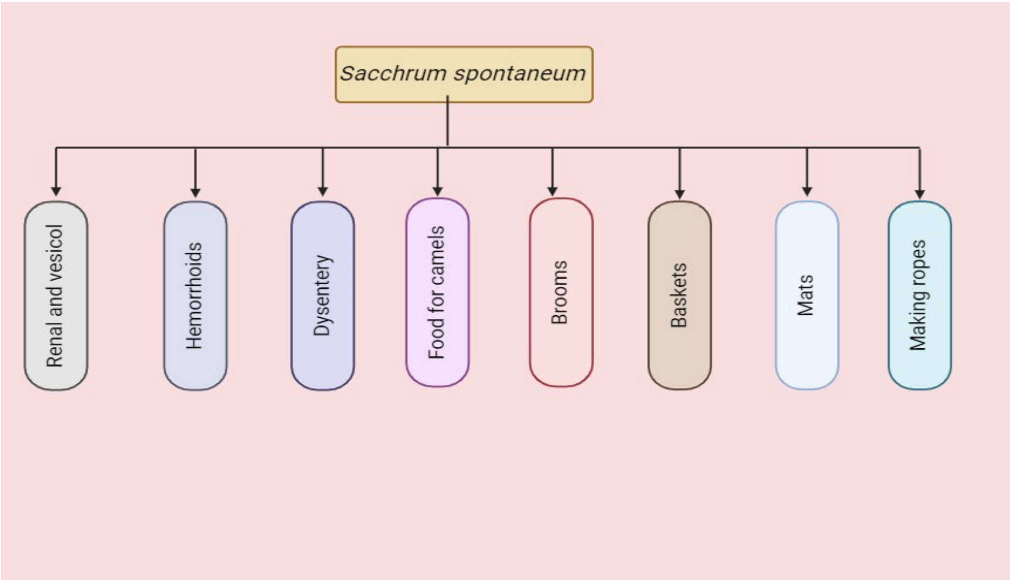


Figure 3. Traditional uses of *Saccharum spontaneum*

Table 2. Traditional uses of different plant parts of *Saccharum spontaneum* L.

Plant parts	Traditional uses	References
Aerial parts	Anemia, dyspnea, vomiting, mental illnesses, stomach problems, and fatness.	(Rajkumar *et al.*).
Leaves	Building ropes, baskets, mats, brooms, and houses. Camels and goats' food	(Shaheen *et al.*, 2020).
Leaves	Ropes, pulllas (a traditional mat) and brooms	(Singh *et al.*, 2014).
Stem juice	Mental illness and disturbances.	(Kodali & Banu, 2016)
Roots	Burning feeling in the stomach, piles, weakened sexual drive, gynecological issues, and respiratory issues	(Kumar *et al.*, 2010).
Roots	Dyspepsia, burning feelings, piles, sexual weakness, gynecological issues, respiratory issues.	(Padalia & Chanda, 2015).
Culm	A reliable source of pulp for making various grades of paper, particularly greaseproof paper	(Shaheen *et al.*, 2020).
Cell wall	contain carbohydrates, an appropriate substrate for the synthesis of ethanol.	(Chandel *et al.*, 2011 ; Scordia *et al.*, 2010)
Stem	Stem burning feeling, hemorrhoids, agalactia phthisis, menorrhagia dysentery, and dyspepsia.	(Kumar *et al.*, 2010).
Stem Juice	Heal mental disorders and disturbances	(Rajkumar *et al.*).
Roots	Used for galactagogue, and diuretic urinary tract infections.	(Lapuz *et al.*, 2016).
Aerial parts	Possess laxative and aphrodisiac properties	(Jeyaraman Amutha Iswarya Devi & Arumugam Kottai Muthu, 2015)
Leaves	Used for cathartic and diuretic action.	(Khalid *et al.*, 2011 ; Kodali & Banu, 2016)
Whole plant	For burning sensations, vesicles calculi, stranguiry, biliousness, galactagogue, and Obesity.	(Ghani, 1998; Kirtikar & Basu, 2005).
Whole plant	Anemia, obesity, dyspnea, mental illnesses, vomiting, and stomach ailments	(Padalia & Chanda, 2015).
Whole plant	For purgative, tonic, diuretic, astringent, emollient, and aphrodisiac properties, sexual weakness, burning sensation, piles, gynecological problems, vomiting, mental conditions.	(Hussain *et al.*, 2014).

Phytochemistry

Saccharum spontaneum root extracts contain secondary metabolites which can be identified through phytochemical analysis of different extracts, thereby revealing the phytochemical content of the plant (Fatima *et al.*, 2018). The root extract of S. spontaneum exhibits strong antioxidant and free radical scavenging activities. This could be caused by several phytoconstituents, such as glycosides, phenolic components, alkaloids, flavonoids, tannins, steroids, and terpenoids. According to the study's findings, *S. spontaneum* root may be a valuable natural antioxidant source that could be used as a therapeutic agent to prevent disease, maintain good health, and increase longevity (Sathya & Kokilavani, 2013).

Among the important phytoconstituents present in the leaves of the plant are Quinones, Terpenes, Alkaloids, Phenolic Compounds, Coumarins, Saponins, Tannins, Steroids, proteins, and Carbohydrates. *S. spontaneum* is a highly attractive feedstock for fuel ethanol production in the future due to its quick growth without the need for financial input (Chandel *et al.,* 2009). The elevated level of carbohydrates (67.9% by weight) of the plant stem indicates that it is a suitable supporting material for fuel ethanol bioconversion (Scordia et al., 2010). Together, cellulose and hemicellulose account for all of *S. spontaneum*'s carbohydrates. Given the increasing significance of biomass energy, it is now routine practice to explore new or novel Lignocellulosic biomass (LB) feedstocks (Equihua-Sánchez & Barahona-Pérez, 2019). *S. spontaneum*, sometimes known as sarkanda, kans, or wild sugarcane a perennial rhizomatous grass in the Poaceaceae family has the potential as a feedstock for the synthesis of biofuel (Mishra & Ghosh, 2020). The main places where *S. spontaneum* biomass (SSBs) are found include tropical countries in Asia, Africa, Australia, and America. It is frequently grown in Pakistan, Bangladesh, India, Nepal, and Sri Lanka. It is native to South Asia, specifically India. Approximately 80 tons of harvest are produced in each hectare in Pakistan (Pandey et al., 2015). Commercially speaking, SSB is not very significant. It grows well on marginal ground and needs little water to flourish. Even though SSB also lignin (26%), extractives (6.14%), and ash (3.3%) are also present in SSB, its 70% polysaccharide content makes it an excellent renewable feedstock for ethanol-biofuel synthesis (Baruah et al., 2020; Mishra & Ghosh, 2020). Research on the bioconversion of sodium bromide has been conducted using pretreatments like potassium hydroxide, sodium hydroxide, or sulfuric acid (Baruah et al., 2020; Popy et al., 2020). However, the pretreatment of SSB using a combination of Ionic Liquids (ILs) and surfactant has not been studied.

Industrial applications of the plant:

On a dry solid basis, *S. spontaneum* has been shown to have 22.75 ± 0.28% hemicellulose 45.10 and ± 0.35% cellulose. Its high proportion of hemicellulosic and cellulosic materials has made it a preferred renewable bioresource for the synthesis of second-generation ethanol and green polymer composites (Baruah, 2023). Even though a recent study suggested *that S. spontaneum* might have industrial applications, such as separating bleached pulp free of chlorine for the paper industry, Microcrystalline cellulose (MCC), one of the high-value cellulosic materials, has not been the subject of considerable research. Microcrystalline celluloses (MCC) are partially depolymerized celluloses, as opposed to being routinely created from various α-cellulosic precursors by treating them with mineral acids to lessen the degree of polymerization (Baruah et al., 2020).

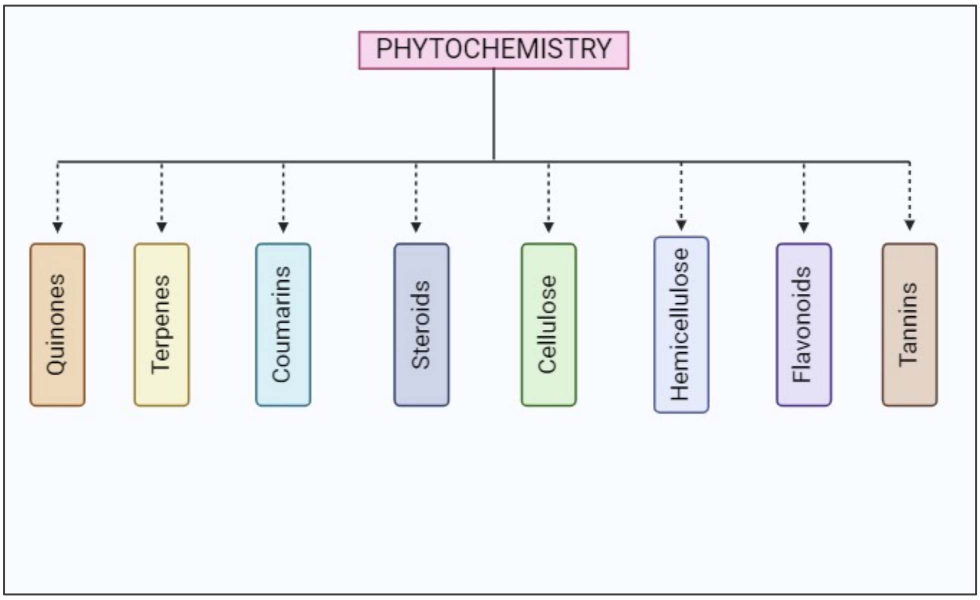
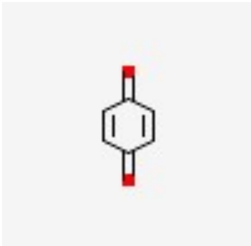
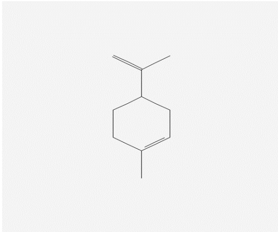
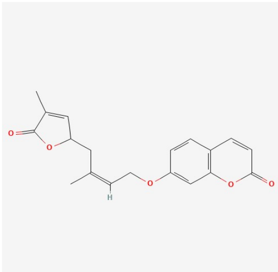
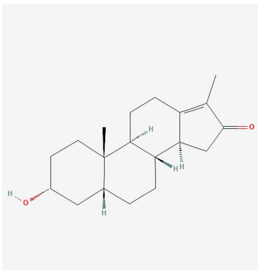
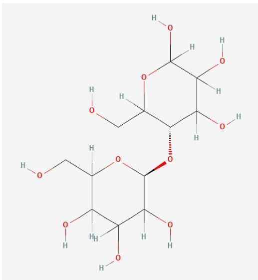


Figure 4. Phytochemistry of *Saccharum spontaneum*

Table 3. List of chemical compounds of *Saccharum spontaneum*

List of compounds	Molecular formula	Structure	References
Quinones	$C_6H_4O_2$		(Chandel *et al.*, 2009)
Terpenes	$C_{10}H_6$		(Chandel *et al.*, 2009)
Coumarins	$C_{19}H_{18}O_5$		(Chandel *et al.*, 2009)
Steroids	$C_{19}H_{28}O_2$		(Chandel *et al.*, 2009)
Cellulose	$C_{12}H_{22}O_{11}$		(Equihua-Sánchez & Barahona-Pérez, 2019).

Pharmacological activities of *Saccharum spontaneum*

1. Anti-urolithiasis activity

It has been reported that *Saccharum spontaneum* ethanol root extract exhibits anti-urolithiasis activity in rats, protecting against urolithiasis induced by ethylene glycol and glycolic acid. Rats with urolithiasis show elevated urinary concentrations of urea, uric acid, calcium, oxalate, and creatinine when exposed to ethylene glycol, whereas rats with glycolic acid show elevated levels of sodium, potassium, chloride, protein, and lipid peroxidation. Rats with urolithiasis that received 200 and 300 mg/kg p.o. of *Saccharum spontaneum* ethanol extract had their levels returned. Additionally, the alterations in the lysosomal enzymes such as xanthine oxidase, n-acetyl-d-glucosaminidase in the serum, kidney, and urine, and β-D-glucuronidase in the kidney and liver, of the rats with urolithiasis are corrected by the ethanol extract (Sathya & Kokilavani, 2013).

2. Anti-obesity activity

It has been shown that 200 and 400 mg/kg (p.o.) of *Saccharum spontaneum* ethanol extract has anti-obesity effects on obese rats caused by the High Fat Diet. The impact of a high-fat diet on food consumption and weight increase, glucose levels, lipid levels, and organ weights were all reversed by *Saccharum spontaneum* ethanol extract (Lamba *et al.*, 2023).

3. CNS depressant activity

To determine the impact of aqueous, ethanolic, and chloroform extract on locomotor activity at 1000 mg/kg (p.o.), (Vhuiyan *et al.*, 2008) investigated the effects on rats. Each of these extracts reduced the amount of movement, demonstrating the drug's CNS depressant effect. In a different investigation, methanol extract dramatically decreased locomotor activity in the hole cross and open field tests. Compared to 200 mg/kg, this extract's CNS depressant activity was more pronounced at 400 mg/kg (Vhuiyan *et al.*, 2008).

4. Anti-psychotic activity

The antipsychotic activity of aqueous and ethanol extract was studied in male Wistar rats at 1000mg/kg by using the Pole climbing model. Compared to the control group, the *Saccharum spontaneum* aqueous and ethanol extract delays the latency to climb the pole. This study demonstrated *Saccharum spontaneum*'s antipsychotic effects in rats (Kumar *et al.*, 2010).

5. Anti-bacterial activity

Saccharum spontaneum flower extract (500µg/disc) exhibited a modest level of antibacterial activity. Disc diffusion showed zones of inhibition in an antimicrobial investigation against four Gram-positive (*Bacillus subtilis*, *B. Megateriu, Sarcina lutea,* and *Staphylococcus aureus*) and eight Gram-negative (*Pseudomonas aeruginosa, Salmonella typhi, S. Paratyphi, Shigella boydii, Shigella senteriae, Vibrio parahemolyticus, Escherichia coli and Vibrio mimicus*). *Shigellady senteriae* growth was significantly suppressed in comparison to the other bacteria tested.

Using the Kirby-Bauer Disk Diffusion Method, the antimicrobial activity of ethanol root extract (0.5%, 1%, 1.5%, and 2%) was investigated against the bacteria *Pseudomonas aeruginosa, S. epidermidis, Staphylococcus aureus* was inhibited from growing at concentrations of 1.5% and 2.0% by the ethanol root extract of *S. spontaneum Linne*. The plant extract did not affect *Pseudomonas aeruginosa* (Lapuz *et al.*, 2016).

6. Anti-fungal activity

The flower extract of *Saccharum spontaneum* (500µg/disc) exhibited antifungal properties against *Candida albicans*, *Aspergillus niger*, and *Saccharomyces cerevisiae*. *Aspergillus niger* showed the largest zone of inhibition of all the investigated fungus (Ripa *et al.*, 2009).

7. Cytotoxic activity

The cytotoxic activity of *Saccharum spontaneum* (flower chloroform extract) was determined using the brine shrimp lethality test. The effects of different quantities of extract (80µg/ml, 40µg/ml, 20µg/ml, 10µg/ml, and 5µg/ml) on brine shrimp (*Artemia salina*) nauplii were studied. The extract's LC50 values were found to be 10.64µg/ml (Ripa *et al.*, 2009).

8. Anti-oxidant activity

Using doses ranging from 100 to 500µg/ml, the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging experiment was used to examine *S. spontaneum*'s anti-oxidant activity. It demonstrated a high capacity to scavenge DPPH radicals at 500µg/ml (Sathya & Kokilavani, 2013). The chloroform extract demonstrated antioxidant activity in a different investigation, with an IC50 value of 51.04 µg/ml. This suggests that *S. spontaneum* may be used as an effective antioxidant and free radical scavenger in the treatment of a variety of illnesses (Ripa *et al.*, 2009).

9. Anti-inflammatory activity

When used in conjunction with carrageenan to cause paw edema in mice, cream of root extracts demonstrated anti-inflammatory action. Carrageenan (1%), 0.1ml injection was used to cause inflammation. A digital Vernier caliper was used to evaluate the degree of inflammation at 0, 1, 2, and 3 hours following the shock. The plant's pre-made 2% root extract lotion has anti-inflammatory properties, according to the study's findings. (Lapuz *et al.*, 2016).

10. Anti-diarrhoeal activity

The anti-diarrheal effects of 400 and 200 mg/kg, p.o. of methanol extract were assessed in mice. In mice with castor oil-induced diarrhea, there was a dose-dependent reduction in the overall quantity of fecal droppings (Kumar *et al.*, 2010).

11. Hypolipidemic Activity

S. spontaneum (ethanol extract of whole plant) showed a hypolipidemic effect at 200 and 400 mg/kg in rats fed with an atherogenic diet (J Amutha Iswarya Devi & A Kottai Muthu, 2015).

12. Safety and Toxicity

In the acute toxicity research, rats given an ethanol extract of roots up to a dose of 2000 mg/kg showed no clinical signs or mortality. An acute toxicity investigation found that ethanol extract is safe up to 2000 mg/kg (Sathya & Kokilavani, 2012). Rats exposed to ethanol extract of roots for 28 days at repeated doses in an oral toxicity study found no harm up to 500 mg/kg (Sathya & Kokilavani, 2012).

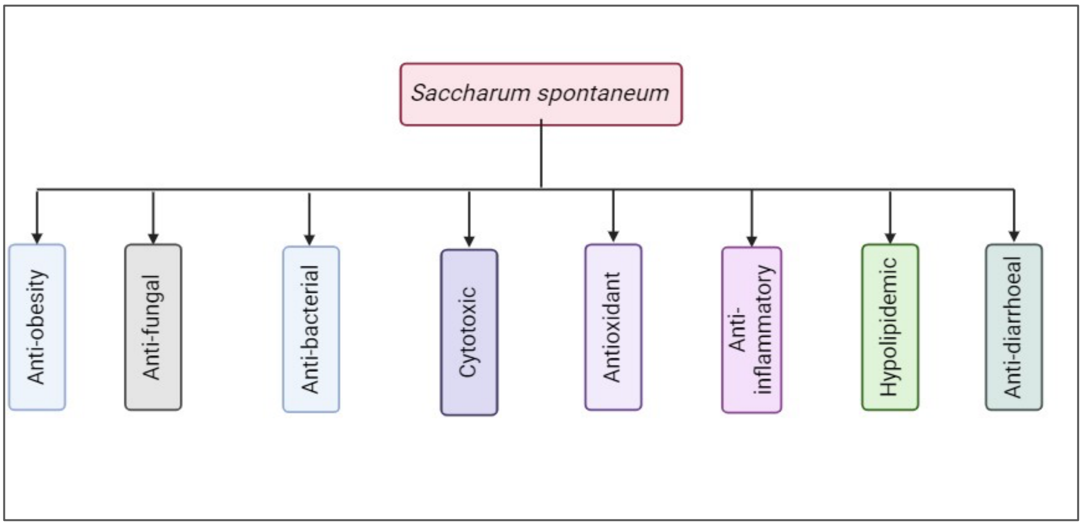


Figure 5: Pharmacological uses of *Saccharum spontaneum*

Conclusion

Saccharum spontaneum, sometimes referred to as wild sugarcane or wasteland weed, is a multipurpose botanical resource with a rich phytochemistry, a wide range of medicinal actions, and extensive traditional usage. It has been used into traditional medical practices for treating a variety of illnesses, from gastrointestinal disorders to mental health issues, in many different regions, most notably in South Asia. Its broad range of medicinal properties, including antioxidant, anti-urolithiasis, anti-obesity, CNS depressant, antibacterial, antifungal, cytotoxic, anti-inflammatory, anti-diarrheal, and hypolipidemic effects, are supported by a complex array of phytoconstituents, including alkaloids, flavonoids, tannins, and terpenoids. Furthermore, due to its high carbohydrate content and quick growth, *S. spontaneum* shows promise as a sustainable biomass feedstock for fuel ethanol production. Its flexibility goes beyond usage in medicine to include a range of industrial applications such as mulching, papermaking, and the production of rope and mats. Its low levels of toxicity are confirmed by safety evaluations, which strengthens its position as a potential therapeutic agent. In summary, this thorough analysis highlights *S. spontaneum* as a noteworthy botanical resource with important pharmacological and industrial implications, deserving of further investigation and study in both conventional and modern medicinal fields.

Declarations

List of abbreviatons: per orem (p.o.), Ionic Liquids (ILs), Microcrystalline celluloses (MCC), *Saccharum spontaneum* biomass (SSBs), Lignocellulosic biomass (LB), Central Nervous System (CNS).

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Authors' contributions: AH collected, organized and wrote the manuscript. **KM** conceived the idea and guided through the whole review. **SAMN** formatted and performed revisions of the whole article. **HS** and **KK** helped in collection of data and in formatting the manuscript.

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Table 3. Pharmacological activities of *Saccharum spontaneum*

Pharmacological activity	Test/Model	Animal/Organism used (dose with route of administration)	Extract (part used)	References
Anti-urolithiasis activity	Ethylene glycol and glycolic acid-induced urolithiasis	Rats (200, 300 mg/kg, p.o.)	Ethanol extract (root)	(Sathya & Kokilavani, 2013).
Anti-obesity activity	High-fat diet	Rats (200, 400 mg/kg, p.o.)	Ethanol extract (whole plant)	(Lamba *et al.*, 2023)
CNS depressant activity	Open field and hole cross-tests	Rats (200, 400, 1000mg/kg p.o.)	Aqueous, Ethanol, chloroform, methanol extract (stem)	(Vhuiyan *et al.*, 2008)
Anti-psychotic activity	Pole climbing model	Rats (1000 mg/kg, p.o.)	Aqueous, Ethanol extract (stem)	(Kumar *et al.*, 2010)
Anti-bacterial activity	Kirby-Bauer Disk Diffusion Method	*Salmonella paratyphi, Salmonella typhi, Staphylococcus aureus, Sarcina lutea, S. epidermidis, Bacillus megaterium, B. subtilis, Shigella boydii, Shigella dysenteriae, Vibrio mimicus, V. parahemolyticus, Escherichia coli, Pseudomonas aeruginosa* (500µg/disc)	Chloroform extract (flowers)	(Lapuz *et al.*, 2016)
Anti-fungal activity	--	*Candida albicans, Aspergillus niger, Sacharomyces cerevaceae* (500µg/disc)	Chloroform extract (flowers)	(Ripa *et al.*, 2009).
Cytotoxic activity	Bioassay for the lethality of brine shrimp	Brine shrimp activity (*Artemia salina*) Nauplii (5, 10, 20, 40, and 80µg/ml)	Chloroform extract (flowers)	(Ripa *et al.*, 2009).
Anti-oxidant activity	Assay for using 1,1-diphenyl-2 Picrylhydrazyl (DPPH) to scavenge free radicals	Examine in vitro (20, 40, 80, and 100 µg/ml)	Chloroform extract (flowers)	(Ripa *et al.*, 2009).
Anti-inflammatory activity	carrageenan-induced paw edema test	Mice (0.5%, 1%, 1.5%, and 2% root extract cream, topically applied)	Ethanol extract (root)	(Lapuz *et al.*, 2016).
Anti-diarrhoeal activity	Diarrhea caused by castor oil	Mice (400, 200 mg/kg, p.o.)	Methanol extract (whole plant)	(Kumar *et al.*, 2010).
Hypolipidemic Activity	Atherogenic diet-induced hyperlipidemia	Rats (200 and 400mg/kg, p.o.)	Ethanol extract (Whole plant)	(J Amutha Iswarya Devi & A Kottai Muthu, 2015)
Toxicity study	Acute toxicity study Examination of subacute toxicity	Rats (2000 mg/kg, p.o.) Rats (100, 200, 300, 400 and 500 mg/kg, p.o.)	Extract from ethanol (root) Ethanol extract (root)	(Sathya & Kokilavani, 2012).