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A comprehensive review on the phytochemistry and various pharmacological activities of *Saccharum benghalense*

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ABSTRACT

Antibacterial plants have been known from the days of the ancient Arabs, Egyptians, and Romans. The current review was based on the phytochemistry and various pharmacological activities of *Saccharum benghalense*. Known by common names Kana, Sarkanda, and Moonja, the plant is widespread in northern and western India as well as Pakistan and Afghanistan. *Tripidium benghalense*, sometimes known as Munj Grass, is synonym with *Saccharum benghalense*. It grows beside river banks and in desert areas. The greenish brown panicles on the tall grass have a smoothness. Overgrown, the grass stands up to seven feet high. Usually considerably longer than the typical internode, the straight, pale straw-coloured leaf sheaths have villous at the tip and long white hairs. It was found that the several plant parts have been used to treat erysipelas, urinary issues, burning sensations, throat, herpes, dyspepsia, dyscaria, and eye diseases. Several ayurvedic formulations include the active component, plant root, which is used to treat dysuria, vertigo, and giddiness. The study concluded that Saccharum Bengalense is a rich source of phytochemicals and that related species have a variety of documented medicinal properties, such as anti-inflammatory, anti-psychotic, antifungal, anti-oxidant, antimicrobial, anti-leishmanial, cytotoxic, anti-urolithiasis, anti-diabetic and neuroprotective effects. As a result, it may be a potential herbal remedy with little chance of adverse effects for a variety of illnesses.

Keywords: *Tripidium bengalense*, phytochemistry, antioxidant, cytotoxicity, biological properties.

INTRODUCTION

The barks, leaves, roots, fluids, gums, fruits, and seeds of plants are used as powders or solutions to cure a variety of illnesses. Because Saccharum munja is a medicinal plant, inorganic nutrients were found in the stem, flowers, and nearby soils [1].

Morphological description

Tripidium bengalense, popularly known as munj grass, is synonymous with *Saccharum benghalense*. It grows along riverbanks and in desert areas. The tall grass's panicles are smooth and greenish brown in hue. The grass is overgrown and reaches a height of seven feet. With long white hairs that are typically much longer than the typical internode, the straight, pale straw-colored leaf sheaths are villous at the apex. Sometimes the tallest sheath reaches beyond the base of the panicle [2]. It has aesthetic significance because of its white flowers.

Fig 1. *Saccharum benghalense*

Taxonomy

Kingdom - Plantae

Class - Liliopsida

Order - Poales

Family - Poaceae

Genus - *Saccharum/ Tripidium*

Species - *benghalense*

Geographical description

The plant, which is widespread in northern and western India, Pakistan, and Afghanistan, is also referred to by its common names, Kana, Sarkanda, and Moonja. Because cattle and buffalo only eat the new leaves when there is a food shortage, the large tufted grass plant is not very useful as fodder. Chiks and moorhas are made from the stem [3]. It is indigenous to Iran, Bangladesh, Nepal, Afghanistan, Pakistan, Myanmar, and northern India. One of the main areas of native distribution is northeastern India, especially Assam in the Terai-Duar grasslands near the base of the Himalayas [4].

Traditional uses

These are following mentioned medicinal uses of munj grass [5][6]-

- It acts as refrigerant.
- Thrush, herpes, duypepsia, erysipelas, burning, dyscaria, urinary issues, and eye illnesses can all be treated with Saccharum munja.
- Vertigo, giddiness, and dysuria are all treated with roots.
- It is used to prevent blood from flowing from wounds.
- Furthermore, roots are used to treat fever and inflammation.
- To block blood flow, saccharunm munja grass is utilized as a sort of gauze pad.
- After giving birth, the smoke from burning roots scalds the skin.

Phytochemicals

Saccharum benghalense exhibited a high level of presence of several moieties during the initial screening of phytoconstituents. There were significant amounts of alkaloids, terpenoids, flavonoids, phenols, coumarins, and betacyanins. In contrast, substantial amounts of cardiac glycosides, tannins, and steroids were found. Anthocyanins, glycosides, and saponins were not present. Saccharum benghalense showed the following phytoconstituents following first screening [7]-

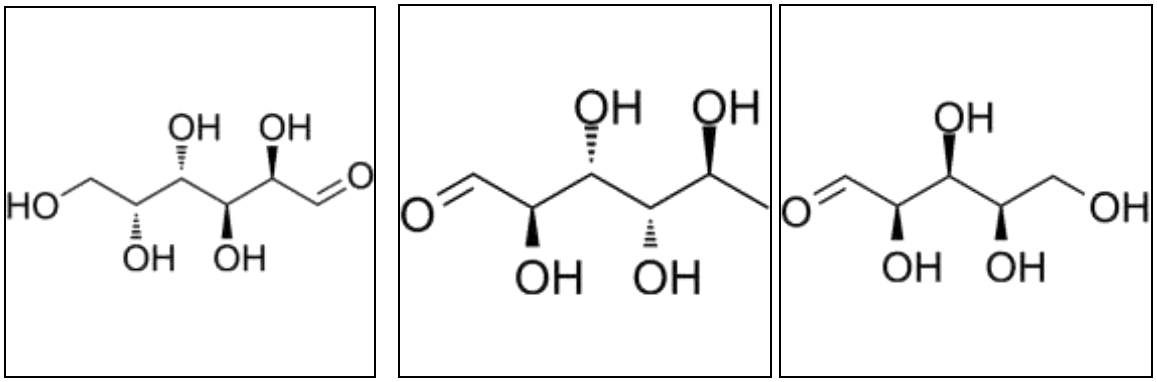
Table 1. Phytochemicals in *Saccharum benghalense* leaf extract

Phytoconstituents	*Saccharum benghalense* leaf extract
Alkaloids	++
Glycosides	–
Cardiac glycosides	+
Tannins	+
Saponins	–
Terpenoids	++
Steroids	+
Flavonoids	++
Phenols	++
Coumarins	++
Anthocyanin	–
Betacyanin	++

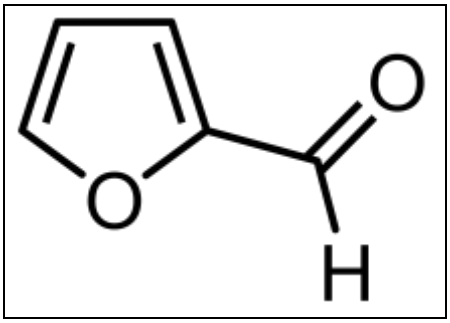
Absent (-), Present (+), Abundance (++)

Table 2. Some active constituents of *Saccharum benghalense* [8]

Part	Active constituent
Whole plant	D-Galactose
Whole plant	D-Glucose
Whole plant	L-Rhamnose
Whole plant	D-Xylose
Whole plant	Furfural
Stem	Furfural
Stem	D-Galactose
Stem	L-Rhamnose



D-Galactose/glucose Rhamnose D-Xylose



Furfural

Fig 2. Diverse active constituents of *Saccharum benghalense*

Pharmacological properties

Neuroprotective

The screening of hydroalcoholic extracts of Saccharum benghalense for phytoconstituents and neuroprotective properties served as the foundation for the study. The Saccharum benghalense leaves came from the Uttar Pradesh region of Rohilkhand. The botanist identified the plant and verified its authenticity. After being cleaned to remove dust, the leaves were allowed to dry at room temperature or in the shade. After drying, the leaves were ground into coarse and then fine powders. The powder is weighed and extracted using a hydro-alcoholic solution (a 1:1 mixture of water and ethanol) in a cold maceration procedure. The initial screening of phytoconstituents was carried out using the plant extract. Wistar albino rats weighing 120–140g of either sex were supplied from the animal house of the pharmacy department at MJP Rohilkhand University in Bareilly. With a 12-hour light/dark cycle and room temperatures of 25°C, the animals were maintained in good health. The rats were split into four groups: group 1 received normal saline; group 2 received sodium arsenite (40 mg/kg/day, p. o.); group 3 received sodium arsenite (40 mg/kg/day, p. o.) plus hydroalcoholic leaves extract of Saccharum benghalense (HLSB), 200 mg/kg/day, p. o.; and group 4 received sodium arsenite (40 mg/kg/day, p. o.) + hydroalcoholic leaves extract of Saccharum benghalense (HLSB) for 21 days. Both behavioral (EPM, light/dark arena, FST) and biochemical (SOD, lipid peroxidation) measures showed neuroprotective effect. In comparison to rats treated with sodium arsenite, Saccharum benghalense demonstrated strong antioxidant and neuroprotective effects across all parameters. Its antioxidant activity is demonstrated by the reduction in lipid peroxidation. Animals given the herbal extract of Saccharum benghalense also showed a decrease in SOD levels, which suggests that it has neuroprotective properties. In conclusion, Saccharum benghalense hydro-alcoholic leaf extract is an important herbal medication that has antioxidant and neuroprotective properties. In the future, it may be possible to identify and isolate the chemical elements that are responsible for an effective medicinal moiety [7].

Antioxidant

ELISA was used to assess antioxidant activities and perform preliminary phytochemical experiments; IC50 values and AAI (%) were noted. For statistical studies, ANOVA was employed. Using p1391Z plasmid DNA, a DNA damage protection experiment was performed, and DNA bands were examined. MIC and Activity Index were calculated using the disc diffusion method to measure antimicrobial activity. The brine shrimp assay was used

to test for cytotoxic activity, and the probit analysis program was used to determine the LC50 values. Secondary metabolites were found in the majority of plant extracts, according to phytochemical analyses. The highest antioxidant potential was found in DaAEE and DaAAE (AAI-49.13% and 44.52%), as well as DiAEE and DiAAE (AAI-54.54% and 43.24%). PoAEE and PoAAE, on the other hand, demonstrated the lowest antioxidant potential (AAI: 41.04% and 34.11%). Very little DNA damage prevention activity was demonstrated by SaSEE, DiAEE, and ElIEE. While DaAAE and ImCAE demonstrated the highest inhibition (eight microorganisms out of eleven tested microbes) among acetone plant extracts, DaAEE considerably inhibited the growth of the majority of microbial pathogens (nine microbes out of eleven tested microbes) among ethanol extracts in the antimicrobial experiment. PoAEE and PoAAE, however, exhibited the least amount of antibacterial action. The microorganisms that were found to be the most resistant were F. oxysporum and A. niger. In comparison to the other plant extracts, ImCEA and ImCAE demonstrated the highest cytotoxic potential (LC50 11.004 ppm and 7.932 ppm) [9].

Antimicrobial

This study evaluated Saccharum spontaneum's (Family: Poaceae) antibacterial activity against human pathogenic bacterial strains. In vitro antibacterial experiments using the disc diffusion method were conducted on nutrient agar to ascertain the percentage zone of inhibition. The whole plant extract showed the significant zone of inhibition (mm) against Staphylococcus aureus (17.00), Streptococcus pneumoniae (16.50), Bacillus cereus (15.90), Bacillus pumilus (15.45), Escherichia coli (18.00), Klebsiella pneumoniae (17.10), Pseudomonas aeruginosa (15.20), and Citrobacter freundii (14.00), with relative percentages of inhibition of 76.90, 71.60, 57.40, 56.85, 70.40, 69.90, 61.05, and 54.30, respectively. The modified agar well diffusion method was used to estimate the minimum inhibitory concentration (MIC), which varies from 75 to 300 ng/ml for G+ve strains and from 75 to 600 ng/ml for G-ve strains. It inhibits bacterial growth on most regulatory levels, such as peptidoglycan, DNA, RNA, and protein production, due to the tannins and flavonoids it contains [10].

Anti-leishmanial

According to the phosphomolybdenum assay, Saccharum spontaneum (L) and Mangifera indica (L) exhibited the highest total antioxidant capacity (~108 and ~100 µg AAE/g of DW, respectively) when compared to the other plants that were studied. S. spontaneum demonstrated remarkable scavenging activity on 1,1-diphenyl-2-picrylhydrazyl (EC50 44.9 µg/mL). S. spontaneum and C. sativa had the lowest toxicity levels (CC50, 113.0 and 109.4 µg/mL, respectively). Additionally, axenic amastigotes and L. major promastigotes showed dose-dependent growth inhibition in the in vitro evaluation of plant CMEs' antileishmanial activity [11].

Cytotoxicity

The purpose of the study was to investigate the floral extract, Saccharum spontaneum Linn. (Gramineae Family), for its antibacterial, cytotoxic, and antioxidant qualities in vitro. The disc diffusion technique was used to test for bacterial and fungal infections in vitro. Zones of inhibition were observed in disc diffusion for antibacterial research against four Gram-positive and eight Gram-negative harmful microorganisms. The extract's average zone of inhibition was shown to be between 9 and 14 mm. There was a large 14 mm zone of inhibition observed against Shigella dysenteriae. In antifungal screening, the compound showed mild to moderate zones of inhibition against three tested fungi. The cytotoxic properties of the crude extract were determined using the Brine shrimp lethality Bioassay and the LC50 values of standard vincristin sulphate as a positive control. The cytotoxic activities of the crude extract were 6.63µg/ml and 10.64µg/ml, respectively, according to the data. However, at 51.04µg/ml and 43.04µg/ml, respectively, the IC50 values for the crude chloroform extract and standard ascorbic acid showed antioxidant activity [12].

Anti-urolithiasis

Rats have been shown to be protected against urolithiasis caused by ethylene glycol and glycolic acid by the ethanol root extract of Saccharum spontaneum. Glycolic acid-exposed rats exhibit increased levels of sodium, potassium, chloride, protein, and lipid peroxidation, whereas urolithiasis-exposed rats exhibit elevated urine concentrations of urea, uric acid, calcium, oxalate, and creatinine. After receiving 200 and 300 mg/kg p.o. of Saccharum spontaneum ethanol extract, rats with urolithiasis displayed recovered levels. Furthermore, rats with urolithiasis have ethanol extract that corrects changes in lysosomal enzymes including xanthine oxidase, ß-D-glucuronidase in the kidney and liver, and n-acetyl-d-glucosaminidase in the urine, serum, and liver [13].

Anti-obesity

An ethanol extract of Saccharum spontaneum was found to provide anti-obesity effects in obese rats fed a high-fat diet at 200 and 400 mg/kg (p.o.). All of the detrimental effects of consuming a high-fat diet, such as weight gain, blood sugar, cholesterol, and organ weights, were reversed by saccharum spontaneum ethanol extract [14].

Anti-psychotic

The anti-psychotic effectiveness of ethanol and aqueous extract was examined in male wistar rats at 1000 mg/kg p.o. using the Pole Climbing Model. The ethanol and aqueous extract of Saccharum spontaneum postpones the latency to mount the pole in comparison to the control group. The antipsychotic effects of Saccharum spontaneum on rats were shown in this study [15].

Antifungal

A flower extract from Saccharum spontaneum (500µg/disc) shown antifungal activity against Candida albicans, Aspergillus niger, and Saccharomyces cerevaceae. Aspergillus niger had the biggest zone of inhibition among the fungi that were studied [16].

Anti-diabetic

A category of metabolic disorders known as diabetes mellitus involves insufficient glucose use and too high glucose generation, hence causing hyperglycemia. It is vital to carefully study the effect of the experimental medications using in vitro models before completing in vivo research. The test substances will therefore probably be investigated in vitro for antidiabetic properties such alpha amylase inhibition. Dichanthium annulatum and Saccharum benghalense are members of Poaceae family. Folk medicine has made use of Poaceae plants for a range of conditions including hypertension, diabetes, inflammation, anthelmintic, astringent, ulcerative, diuretic, & antioxidant properties. The assay findings imply that the varied therapeutic qualities of this plant including diabetes could be caused by the presence of bioactive chemicals; the extract shows the IC50 values of alpha amylase inhibitory activity of ethanolic extracts of Dichanthium annulatum and Saccharum benghalense were 110 µg/mL and 189.655 µg/mL respectively, when compared with Acarbose (IC50 65.454 µg/mL). The present work shows by in vitro investigations that the ethanolic extract of Dichanthium annulatum and Saccharum benghalense leaves has antidiabetic action [17].

Anti-inflammatory

Cream of root extracts shown anti-inflammatory activity when taken in combination with carrageenan to cause paw edoema in mice. To induce inflammation, 0.1 ml of 1% carrageenan was injected. At 0, 1, 2, and 3 hours after the shock, the level of inflammation was measured using a digital Vernier calliper. The results of the study indicate that the plant's pre-made 2% root extract lotion possesses anti-inflammatory qualities [18].

Commercial applications

- This species' raw material is used to make roof thatching.
- We make baskets with it.
- They use its fiber to make ropes.
- One of the indigenous mines that has been successfully ecologically colonized is this one.
- In rocky locations, it develops in pure areas on skeletal soils.
- It develops into tall, thick clusters with tufts of high biomass and has a large root system that holds the soil and pebbles together.
- It is used by low-income residents to make baskets, brooms, hand fans, mats, huts, ropes, and shields to protect crops.
- It is the preferred species for rehabilitating rocky, erosion-prone slopes and transforming them into extremely valuable socioeconomic and biological spaces.

CONCLUSION

Fever, irritation, and bleeding wounds have all been treated with the plant in the past. Erysipelas, urinary issues, burning sensations, throat, herpes, dyspepsia, dyscaria, and eye conditions have all been found to be treated with the different plant components. The plant root is used to cure vertigo, giddiness, and dysuria and is an active ingredient in a number of ayurvedic remedies.

The study concluded that Saccharum Bengalense is a rich source of phytochemicals and that related species have a variety of documented medicinal properties, such as anti-inflammatory, anti-psychotic, antifungal, anti-oxidant, antimicrobial, anti-leishmanial, cytotoxic, anti-urolithiasis, anti-diabetic and neuroprotective effects. As a result, it may be a potential herbal remedy with little chance of adverse effects for a variety of illnesses.

CONFLICT OF INTEREST

Authors declare for none conflict of interest.

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