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Pharmacognostic, phytochemical and pharmacological properties of *Saccharum benghalense*: A Review

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A B S T R A C T

Saccharum benghalense is synonym for *Tripidium bengalense* that is also called as munj grass that grows in desert regions and along river banks. The current review was based on the pharmacognostic, phytochemical and pharmacological activities of S*accharum benghalense*. The grass is tall, with smooth, greenish brown panicles. The grass is overgrown and can reach heights of up to 7 feet. Apart from Pakistan and Afghanistan, the plant is rather common in northern and western India. It grows in desert environments as well as next river banks. The greenish brown panicles on the tall grass have a smoothness. Overgrown, the grass towers seven feet high. Usually far longer than the average internode, the straight, pale straw-colored leaf sheaths feature long white hairs and villous at the tip. The numerous plant parts have been utilized to treat erysipelas, urinary problems, burning sensations, throat, herpes, dyspnea, dyscaria, and eye illnesses, it was discovered. Treating dysuria, vertigo, and giddiness, several ayurveda formulations call for the active component—plant root. It found that Saccharum Bengalense is a rich source of phytochemicals and related species have several reported therapeutic activities including Neuroprotective, Antioxidant, Antimicrobial, Anti-leishmanial, Cytotoxicity, Anti-urolithiasis, Anti-obesity, Anti-psychotic, Antifungal, Anti-inflammatory and anti-diabetic potential. Therefore, for certain medical diseases with low likelihood of adverse effects, it could be a good herbal source.

Keywords: *Tripidium bengalense*, ethnopharmacology, antioxidant, antimicrobial, biological properties.

INTRODUCTION

Powders or solutions made from the barks, leaves, roots, fluids, gums, fruits, and seeds of plants treat many diseases. Inorganic minerals were discovered in the stem, blossoms, and surrounding soils since Saccharum munja is a medicinal plant [1].

Pharmacognostic 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* shrub

Taxonomical classification

Kingdom - Plantae

Class - Liliopsida

Order - Poales

Family - Poaceae

Genus - *Tripidium*

Species - *benghalense*

Ecology and geographical description

Often known as Kana, Sarkanda, and Moonja, the plant hails from Pakistan, Afghanistan, northern and western India. A large tufted grass, the plant has little use as fodder as cattle and buffalo only consume the young leaves during a food shortage. The stem produces moorhas and chiks [3]. Natural habitat is Myanmar, Bangladesh, Nepal, Afghanistan, Pakistan, northern India, and Iran. Northeast India, particularly Assam in the Terai-Duar grasslands at the foot of the Himalayas, is a major area of native distribution.

Nutritional contents

Long known since ancient Arab, Egyptian, and Roman civilizations, antibiotic-containing plants... Plant materials treat a range of conditions either in solution form or as a heterogeneous ground mix; these materials include barks, leaves, roots, fluids, gums, fruits, and seeds. Given Saccharum munja's importance in medicine, inorganic minerals were taken from the plant's stem, flowers, and surrounding soils [5][6][7][8].

- The stem (5–10 ppm) has less sodium than the flower (10–40 ppm). The stem's potassium levels (40.8-70.9 ppm) exceed those of the plant's flowers (0.4-10.4 ppm) and soils (10-35 ppm). During muscle contraction and nerve activation, Na+ entering and Ka+ leaving the cell causes the possible differential across the cell membrane to momentarily change. ATP—adenosine triphosphate—is the metabolic energy needed to push Na+ out and Ka+ back for a normal condition. Na+ and Ka+ stabilize the oil in water emulsion and maintain the protein solubility since globulin is soluble in diluted salt solutions but insololuble in water.
- The soil in which Saccharum munja grows has less calcium (0.14-6 ppm) than the plant stem (24-80 ppm) and flowers (24-120 ppm). Calcium is essential as factor IV in the blood coagulation system. Along with thromboplastin, prothrombin has to be changed into thrombin, which then activates

fibrinogen to create the fibrin network. Thromboplastin and prothrombin must be converted to thrombin, which then activates fibrinogen to create the fibrin network. Compared to soil (0.21–1.26 ppm), plant stems (43–430 ppm) and flowers (0.48–48 ppm) have higher magnesium levels.

- Enzymes converting adenosine triphosphate to adenosine triphosphate by phosphate transfer are activated with magnesium. Affecting all necessary cellular processes, including glycolysis, these enzymes are extensively dispersed and crucial. Physical stability of DNA, ribosomes, and chromosomes also depends on magnesium. Therefore, cell division requires a certain quantity of magnesium. While Mg+2 is not absent in the body, it can happen in renal failure and intoxication, which could cause magnesium shortage and resulting symptoms include spasmophilia, depression, and hallucinations. High magnesium consumption could interfere with neuromuscular transmission.
- Soil has a greater iron concentration (172–860 ppm) than plant stems (285–704) and flowers (218–553). The liver and spleen hold one gramme of the four to six grammes of iron comprising the human body. Iron in the body carries oxygen via haemoglobin and myoglobin, hence facilitating cell respiration. Iron is also present in the intracellular cytochrome enzyme system, which generates energy. Iron insufficiency makes pregnancy require a significant iron consumption. Daily iron consumption should be between 10 and 20 milligrams.
- The advised daily iron consumption ranges from 10 to 20 mg. A flower's chloride content (199–500 ppm) and a stem's (157–203 ppm) exceed that of the soil's (17.8–78 ppm). Taken from the soil as chloride ions (Cl-1), chloride is required for acid-base balance, water balance, and osmotic pressure control without creating a structural unit. It might apply to the cell division of roots and leaves.
- Bicarbonates in soil (106-600 ppm) differ from those in the stem (300-710 ppm) and flowers (288-820 ppm). Pancreatic secretion is alkaline in character due to the high concentration of bicarbonate ions. It consists of an enzymatic component from the acinar cells and an aqueous bicarbonate component from the duct cells. This offsets the acidity of stomach acid, hence enabling the enzymes to function.
- Phosphate ions are more plentiful in stems (0.7-1.04ppm) and flowers (0.35-0.8ppm) than in earth (0.1-0.25ppm). Phosphor inside the cell helps to move fatty acids. Two instances of phosphate bonds via which it is used in the storage and transfer of metabolic energy are adenosine triphosphate (ATP) and adenosine diphosphate (ADP).
- Sulfate ions are lower in plant stems (86-154 ppm) and plant flowers (20-240 ppm) than the adjacent soil (100-250 ppm). Sulphur is also responsible for high energy bond formation in lipoic acid derivative acetyl coenzyme-A. Part of the detoxification process, the sulphahudryl group is a chelating agent binding to heavy metals.

Traditional uses

These are following mentioned medicinal uses of munj grass [9][10]-

- Employed as a refrigerant.
- Saccharum munja is beneficial for eye diseases, urinary issues, dyscaria, burning, erysipelas, duypepsia, herpes, thrush, and other conditions.
- Dysuria, vertigo, and giddiness are treated with roots.
- It stops bleeding from wounds leaking.
- Roots are also used to treat fever and inflammation.
- A sort of gauze pad made from Saccharunm munja grass stops blood flow.
- The smoke from burning roots scalds the skin following delivery.

Phytochemicals

Screeing of phytoconstituents revealed Saccharum benghalense to be quite present with many moieties. Abundant were alkaloids, terpenoids, flavonoids, phenols, coumarins and betacyanin. While cardiac glycosides, tannins, steroids were acquired in moderate quantities. Glycosides, saponins, and anthocyanin were missing. Following preliminary screening, *Saccharum benghalense* showed for following phytoconstituents [11]-

Table 1. Phytochemicals reported in *Saccharum benghalense*

Phytoconstituents	Phytochemicals of *Saccharum benghalense*
Glycosides	–

Alkaloids	++
Cardiac glycosides	+
Tannins	+
Saponins	–
Terpenoids	++
Steroids	+
Flavonoids	++
Phenols	++
Coumarins	++
Betacyanin	++
Anthocyanin	–

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

Diverse parts of *Saccharum benghalense* demonstrated the active constituents which is summarized in the blow table;

Table 2. Active constituents of diverse parts of *Saccharum benghalense* [12]

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

Pharmacological properties

Neuromodulator

The study focused on the screening of phytoconstituents and neuroprotective potentials of hydroalcoholic extracts of Saccharum benghalense. Using hydro-alcoholic solution—water and ethanol, 1:1—the powder is weighed and extracted by cold maceration. The plant extract underwent preliminary phytoconstituent screening. Wistar albino rats of either sex weighing 120-140g were provided by the animal house, Department of Pharmacy, MJP Rohilkhand University, Bareilly. With 25°C room temperatures and a 12-hour light/dark cycle, the animals were maintained in good health. Rats were split into four groups: group 1 received normal

saline; group 2, Sodium arsenite (40mg/kg/day, p. o.); group 3, Sodium arsenite (40mg/kg/day, p. o.) plus hydroalcoholic leaves extract of Saccharum benghalense (HLSB), 200mg/kg/day, p. o.; and group 4, Sodium arsenite (40mg/kg/day, p. o.) plus hydroalcoholic leaves extract of Saccharum benghalense (HLSB), 400mg/kg/day, p. o. for 21 days. Behavioural (EPM, Light/dark arena, FST) and biochemicals (SOD, lipid peroxidation) criteria revealed neuroprotective action. Results showed that Saccharum benghalense, when compared with sodium arsenite treated rats, significantly displayed the antioxidant and neuroprotective benefits in all the criteria. It reduced lipid peroxidation, which suggests its antioxidant effect. Animals given the Saccharum benghalense herbal extract indicating for their neuroprotective action also showed reduced SOD levels. To sum up, hydro-alcoholic leaves extract of Saccharum benghalense is important neuroprotective and antioxidant herbal medication. In future considerations, the accountable chemical components could be found and separated for a potent medicinal moiety [11].

Antioxidant

Using ELISA and their IC50 values, preliminary phytochemical studies were conducted and antioxidant activities assessed; AAI (%) was noted. Disc diffusion method was used to measure antimicrobial activity; MIC and Activity Index were calculated. Cytotoxic activity was done utilizing the brine shrimps' assay and probit analysis tool determined LC50 values. Most of the plant extracts have secondary metabolites, as phytochemical research showed. DiAEE, DiAAE (AAI- 54.54% and 43.24%), DaAEE and DaAAE (AAI- 49.13% and 44.52%) showed maximumantioxidant potential. PoAEE and PoAAE, on the other hand, have least antioxidant potential (AAI- 41.04% and 34.11%). SaSEE, DiAEE andElIEE shown relatively low activity in protecting DNA. Among ethanol extracts, DaAEE notably reduced the growth of most of the microbial pathogens (nine bacteria out of eleven tested). Among acetone plant extracts, DaAAE and ImCAE demonstrated greatest inhibition (eight germs out of eleven tested). PoAEE and PoAAE, on the other hand, had least antibacterial activity. The most resistant micro-organisms were found to be F. oxysporum and A. niger. When compared to the other plant extracts [13], ImCEA and ImCAE exhibited greatest cytotoxicity (LC50 11.004 ppm and 7.932 ppm).

Antimicrobial

This work evaluated Saccharum spontaneum (Family: Poaceae)'s antibacterial capacity against human pathogenic bacterial strains. Nutrient agar served as the basis for disc diffusion technique in vitro antibacterial experiments done to find the percentage zone of inhibition. The whole plant's extract showed the notable 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. Ranging from 75 to 300 ng/ml for G+ve bacteria and from 75 to 600 ng/ml for G-ve strains, the modified agar well diffusion technique revealed the minimum inhibitory concentration (MIC). The tannins and flavonoids in it stop bacteria from developing on most regulatory levels, including peptidoglycan, DNA, RNA, and protein production [14].

Anti-leishmanial

When judged by the phosphomolybdenum assay (\u223c108 and \u223c100\u202f\u00b5g AAE/g of DW, respectively), Saccharum spontaneum (L) and Mangifera indica (L) exhibited the highest overall antioxidant capacity among other plants studied. S. spontaneum showed remarkable scavenging activity on 1,1-diphenyl-2-picrylhydrazyl (EC50 44.9 \u00b5g/mL). S. spontaneum and C. sativa were the least toxic strains (CC50, 113.0 and 109.4 µg/mL, respectively). Moreover, the in vitro study of plant CMEs' antileishmanial capacity showed a dose-dependent growth inhibition of axenic amastigotes and L. major promastigotes [15].

Cytotoxicity

The study sought to investigate the in vitro antibacterial, cytotoxic, and antioxidant characteristics of the flower extract, Saccharum spontaneum Linn. (Gramineae Family). The disc diffusion approach was used to look for bacterial and fungal infections in vitro. Zones of inhibition appeared in disc diffusion for antibacterial research against 4 Gram-positive and 8 Gram-negative harmful microorganisms. The extract's average zone of inhibition was discovered to be between 9 and 14 mm. A large 14 mm zone of inhibition was observed against Shigella dysenteriae. In antifungal screening, the compound showed mild to moderate zones of inhibition against three tested fungi. The cytotoxic effects 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 findings revealed that the crude extract had cytotoxic activity of 6.63µg/ml and 10.64µg/ml, respectively. The IC50

values for the conventional ascorbic acid and crude chloroform extract, at 51.04µg/ml and 43.04µg/ml, respectively, showed antioxidant activity, however [16].

Anti-urolithiasis

Studies show that Saccharum spontaneum ethanol root extract protects against urolithiasis brought on by ethylene glycol and glycolic acid in rats. While rats with glycolic acid had greater levels of sodium, potassium, chloride, protein, and lipid peroxidation, rats with urolithiasis have higher urine concentrations of urea, uric acid, calcium, oxalate, and creatinine when exposed to ethylene glycol. Rats with urolithiasis exhibited recovered levels when administered 200 and 300 mg/kg p.o. of Saccharum spontaneum ethanol extract. Ethanol extract also fixes 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 of rats with urolithiasis [17].

Anti-obesity

An ethanol extract of Saccharum spontaneum showed anti-obesity benefits in High Fat Diet-induced obese mice at 200 and 400 mg/kg (p.o.). Saccharum spontaneum ethanol extract reversed all the adverse effects of a high-fat diet, including weight gain, blood sugar, cholesterol, and organ weights [18].

Anti-inflammatory

Cream of root extracts revealed anti-inflammatory effect when combined with carrageenan to cause paw edoema in mice. Inflammation was brought on by 1% carrageenan, 0.1 ml injection. The amount of inflammation at 0, 1, 2, and 3 hours post-shock was measured using a digital Vernier calliper. The study's results [19] indicate that the pre-made 2% root extract lotion of the plant possesses anti-inflammatory qualities.

Antifungal

Extract of Saccharum spontaneum flower (500µg/disc) demonstrated antifungal activity against Candida albicans, Aspergillus niger, and Saccharomyces cerevaceae. Among the fungi studied, Aspergillus niger showed the greatest zone of suppression [20].

Anti-psychotic

Male wistar rats at 1000 mg/kg p.o. were used to test the anti-psychotic effectiveness of aqueous and ethanol extract using the Pole Climbing Model. The Saccharum spontaneum aqueous and ethanol extract postpones the pole ascending latency as compared to the control group. This work showed Saccharum spontaneum's antipsychotic effects on rats [21].

Anti-diabetic

Prior to conducting in vivo experiments, it is essential to meticulously examine the effects of the experimental medications through in vitro models. Consequently, the test compounds will probably be subjected to in vitro antidiabetic evaluation, including alpha amylase inhibitory activity. Dichanthium annulatum and Saccharum benghalense are members of the Poaceae family. Plants of the Poaceae family have been employed in traditional medicine to address several conditions, including hypertension, diabetes, inflammation, anthelmintic needs, astringency, ulceration, diuresis, and antioxidant properties. The assay results indicate that bioactive compounds may account for the diverse medicinal properties of this plant, including its effects on diabetes. The ethanolic extracts of Dichanthium annulatum and Saccharum benghalense demonstrated IC50 values for alpha amylase inhibitory activity of 110 µg/mL and 189.655 µg/mL, respectively, in comparison to Acarbose, which has an IC50 of 65.454 µg/ml [22].

CONCLUSION

The medicinal value of Saccharum munja comes from the nutritional elements contained in its several parts: sodium, potassium, calcium, magnesium, chloride, bicarbonates, iron, phosphate, and sulfate. Historically, the herb has been used to heal bleeding wounds, irritation, and fever. The different plant parts were found to have been used to treat erysipelas, urinary issues, burning sensations, throat, herpes, dyspepsia, dyscaria, and eye disorders. Used to cure vertigo, giddiness, and dysuria, the plant root is an active component in many ayurvedic formulations.

It found that Saccharum Bengalense is a rich source of phytochemicals and related species have several reported therapeutic activities including Neuroprotective, Antioxidant, Antimicrobial, Anti-leishmanial, Cytotoxicity, Anti-urolithiasis, Anti-obesity, Anti-psychotic, Antifungal, Anti-inflammatory and anti-diabetic

activity. Therefore, for certain medical diseases with low likelihood of adverse effects, it could be a good herbal source.

CONFLICT OF INTEREST

Authors declare for none conflict of interest.

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