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JAMUN SEEDS: A NATURAL REMEDY FOR DIABETES

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ABSTRACT

Diabetes mellitus has become one of the most widespread and challenging health conditions of modern times, affecting millions globally. This metabolic disorder, characterized by persistently high blood sugar levels, poses risks of severe complications such as heart disease, kidney failure, nerve damage, and vision loss. While conventional treatments like insulin therapy and oral medications are effective, they often come with limitations such as side effects, high costs, and limited accessibility. In recent years, there has been a growing interest in natural remedies to complement or substitute synthetic drugs. Among these, Jamun (Syzygium cumini) seeds have emerged as a promising option, drawing attention for their potential role in diabetes management.

KEYWORDS: Diabetes Mellitus, Jamun, Medicinal Uses, Toxicity.

INTRODUCTION

Diabetes has become one of the fastest-growing health concerns in the modern world, affecting millions of people across all age groups and regions. Characterized by chronic high blood sugar levels, diabetes occurs when the body either does not produce enough insulin or cannot effectively use the insulin it produces. This metabolic disorder not only increases the risk of life-threatening complications like heart disease, kidney failure, and nerve damage but also places an immense financial burden on individuals and healthcare systems. Despite advancements in pharmaceutical treatments, managing diabetes remains a significant

challenge for many due to the side effects of medications, rising treatment costs, and the progressive nature of the disease. This has led to a renewed interest in exploring alternative therapies derived from natural sources, which offer safer, affordable, and holistic solutions.

Among the many natural remedies, Jamun (Syzygium cumini), commonly known as Indian blackberry or black plum, holds a special place in traditional medicine. Native to the Indian subcontinent and other tropical regions, Jamun has been revered for its medicinal properties for centuries. While its fruit is often consumed for its nutritional benefits, the seeds of Jamun have long been recognized in Ayurveda, Siddha, and Unani medicine for their antidiabetic potential. These seeds, often overlooked or discarded, are packed with bioactive compounds such as jamboline, ellagic acid, and flavonoids that have shown promising effects in regulating blood sugar levels.

The traditional use of Jamun seeds as a remedy for diabetes is welldocumented. They are commonly dried, powdered, and consumed in various forms, believed to help control blood sugar spikes and improve overall metabolic health. In traditional healing systems, Jamun seeds have also been used to address other ailments, such as digestive disorders, inflammation, and urinary problems.

However, their antidiabetic properties have garnered the most attention in recent years, prompting researchers to investigate their potential through modern scientific studies. Preliminary research has begun to validate the hypoglycemic and insulinsensitizing effects of Jamun seeds, highlighting their role in improving glucose metabolism and reducing oxidative stress. However, despite these promising findings, there remains a significant gap in clinical evidence.

Most studies to date have been conductedon animal models or in laboratory settings, with limited large-scale human trials. Furthermore, questions about the optimal dosage, preparation methods, long-term safety, and interaction with other treatments remain unanswered. These gaps hinder the broader acceptance of Jamun seeds in modern medicine and limit their integration into evidence-based diabetes care.

This review aims to explore the untapped potential of Jamun seeds as a natural remedy for diabetes. By examining traditional knowledge, phytochemical composition, mechanisms of action, and existing scientific evidence, it seeks to provide a comprehensive understanding of

how Jamun seeds can contribute to managing this global health challenge. Additionally, this review discusses the limitations and risks associated with their use and offers insights into future research directions. The goal is to bridge the gap between traditional medicine and modern science, paving the way for the development of standardized, safe, and effective Jamun seed-based interventions for diabetes.

In an era where chronic diseases like diabetes continue to rise, there is an urgent need to explore sustainable and holistic solutions. By revisiting nature's pharmacy and unlocking the potential of medicinal plants like Jamun, we may discover new ways to complement existing treatments, improve health outcomes, and empower individuals with safe and affordable options.

Jamun, commonly known as Indian blackberry, has a rich history in traditional medicine systems like Ayurveda and Unani. Though the fruit is well-known for its tangy flavor and nutritional value, it is the seeds that stand out for their therapeutic benefits, particularly for those living with diabetes. Jamun seeds are packed with bioactive compounds such as alkaloids, flavonoids, glycosides, and polyphenols, which contribute to their anti-diabetic properties. These natural compounds work synergistically to regulate blood sugar levels, enhance insulin sensitivity, and reduce oxidative stress, making the seeds a holistic and effective remedy for managing the disease.

Scientific studies have shed light on how Jamun seeds exert their beneficial effects. They are known to inhibit carbohydrate-digesting enzymes like alpha- amylase and alpha-glucosidase, which slows down the breakdown of carbohydrates into glucose. This mechanism helps prevent sudden spikes in blood sugar after meals. Additionally, Jamun seeds have been found to enhance the body's ability to use insulin efficiently, improving glucose uptake by cells. These effects make them especially useful in managing both type 1 and type 2 diabetes.

- **BOTANICAL DESCRIPTION**
- **Tree**
- Medium to large-sized evergreen tree, growing 10–30 meters tall.
- Smooth, greyish bark with reddish tinge when young, developing fissures with age.
- Wide-spreading branches, giving the tree a rounded canopy.

- **Leaves**
- Simple, lance-shaped or elliptical leaves, about 10–25 cm long and 3–6 cm wide.
- Dark green on the upper side, pale green on the underside with slight hairiness.
- Oppositely arranged along the branches with smooth or slightly wavy.

- **Flowers**
- Small, white or pale pink flowers, appearing in dense clusters (panicles).
- Each flower is about 1–1.5 cm in diameter with five delicate petals.
- Mildly fragrant, attracting pollinators such as bees.

- **Fruits**
- Ovoid or elliptical shape, 2–3 cm in length.
- Initially green, ripening to dark purple or black. 18
- Sweet, slightly astringent flavour with a single large seed inside.

- **Roots**
- Deep taproot with widespread lateral roots, helping the tree adapt to various soil conditions.

- **Bark and Stem**
- **Bark:** Greyish-brown to dark brown, often rough and flaking with age.
- **Stem:** Thick, straight trunk with a wide crown that provides dense shade.

Taxonomical classification

- Kingdom: Plantae
- Subkingdom: Viridaeplantae
- Infrakingdom: Streptophyta
- Division: Tracheophyta
- Subdivision: Spermatophytina
- Infradivision: Angiospermae
- Class: Magnliopsida

- Superorder: Rosanae
- Order: Myrtales
- Family: Myrtaceae
- Genus: Syzygium
- Species: Cumini
- Scientific Name: Syzigium cumini**.**

- **CHEMICAL CONSTITUENTS AND BOTANICAL DESCRIPTION**
- **CHEMICAL CONSTITUENTS**

Chemical Constituents of Jamun Fruit (Syzygium cumini): Jamun fruit is packed with a variety of bioactive compounds that contribute to its nutritional and medicinal benefits. These constituents include:

- **Carbohydrates**

Jamun fruit is a source of natural sugars like glucose and fructose, which provide energy. Its dietary fiber content helps improve digestion and regulate blood sugar levels.

- **Proteins**

Though present in small amounts, proteins in Jamun play a role in supporting tissue repair and overall body functions.

- **Anthocyanins**

These are the pigments responsible for the fruit's deep purple-black color. Anthocyanins are powerful antioxidants that protect cells from damage caused by oxidative stress, which is often linked to diabetes and other chronic conditions.

- **Flavonoids**

Compounds like quercetin and kaempferol are present in the fruit. These flavonoids have antioxidant, anti-inflammatory, and anti-diabetic properties, aiding in blood sugar regulation and reducing the risk of diabetes-related complications.

- **Polyphenols**

Jamun contains polyphenols such as gallic acid and ellagic acid. These compounds have strong antioxidant properties, protecting cells from free radical damage and supporting overall metabolic health.

- **Tannins**

Tannins, which give the fruit its slightly astringent taste, have antiinflammatory and antimicrobial effects. They also play a role in maintaining blood sugar levels by slowing down carbohydrate digestion.

- **Alkaloids**

The fruit contains alkaloids like jambosine, which have been shown to regulate blood sugar levels and enhance insulin activity.

- **Vitamins**

Jamun is rich in vitamin C, which supports the immune system and acts as an antioxidant. It also contains vitamin A, which is vital for vision and skin health.

- **Minerals**

The fruit is a good source of essential minerals like potassium, calcium, phosphorus, and iron. These minerals support bone health, muscle function, and overall metabolism.

- **Essential Oils**

Trace amounts of essential oils in Jamun have antimicrobial and anti- inflammatory properties, contributing to the fruit's health benefits.

- **Fatty Acids**

While present in minimal quantities, fatty acids like linoleic acid in Jamun help maintain healthy cell membranes and overall body function.

PHARMACOLOGICAL PROFILE

- A range of pharmacological properties is possessed by various extracts of jamun which include antidiabetic, antihyperlipidemic, antihyper-cholesterolemic, anticancer, cardioprotective, hepatoprotective, neuroprotective, anti- inflammatory, antioxidant, and antimicrobial activities as established by scientific studies.

- **Antidiabetic Activity**

Jamun (Syzygium cumini) has been traditionally used in Ayurveda to manage diabetes, with seed powder commonly administered to control high blood sugar levels. However, its antidiabetic efficacy has shown mixed results in modern studies. Since the 19th century, numerous preclinical studies on various parts of Jamun have been conducted, primarily using

animal models. These studies report both successes and failures in reducing blood glucose levels.

- **Key findings include**
- Aqueous seed extracts have shown glucose-lowering effects in rabbits and diabetic rats.
- Stem bark and ethanol extracts also demonstrated reductions in blood glucose in animal studies.
- Lyophilized aqueous seed extracts and seed powders with water-soluble fibres effectively controlled diabetes in certain models.
- Ethanol seed kernel extracts improved fasting blood glucose, urea, liver and kidney enzyme activity, and antioxidant enzyme levels in diabetic rats.
- Mycaminose, isolated from Jamun seeds, reduced blood glucose levels in specific diabetic models.
- The variability in results suggests that efficacy may depend on factors such as the extract preparation, dosage, and individual biological responses. Further clinical research is needed to confirm these findings in humans.

- **Antihyperlipidemic and Antihypercholesterolemic Activity**

The presence of several bioactive compounds in jamun seeds helps to regulate the blood lipid profile. Oral infusion of an alcoholic jamun seed extract in diabetic rats resulted in a significant reduction in serum lipids.

The jamun seed extract also decreased the total serum cholesterol to high-density lipoprotein (HDL) cholesterol ratio, serum low-density lipoprotein (LDL) cholesterol level and 3-hydroxy-3-methyl-glutaryl-coenzyme A (HMG-CoA) reductase activity in alloxan-induced diabetic rabbits and streptozotocin-induced diabetic rats The plasma lipoprotein cholesterol (HDL-, LDL-, and VLDL-C) and fatty acid composition were altered in streptozotocin-induced diabetic rats when administered the ethanolic jamun seed extract.

- **Anticancer Activity**

Jamun seed extract exhibited protection in albino mice against peroxidative damage contributing to skin cancer The oral intake of extracts (125 mg/kg body weight) reduced tumour burden, number of papilloma cells and their size In experiments of Arun etal.[2011]

- **Cardio- and Hepatoprotective Properties**

The methanolic jamun seed extract administered to mice at the dose of 200 mg/kg body weight revealed the protective and recovery ability on cardiac tissue due to its capability to decrease myocardial necrosis biomarkers such as aspartate aminotransferase (AST), alanine transaminase (ALT), uric acid, creatine phosphokinase (CPK), and lactate dehydrogenase (LDH) Atale et al. [2013] reported reduction in size of myocyte, lower generation of reactive oxygen species (ROS), and lower accumulation of collagen in response to the administration of the jamun seed extract. According to the study of Devkar et al [2012], jamun seeds are potential cardioprotective agents due to a higher content of phenolic compounds, can reduce intracellular oxidative stress, preventing depletion of cellular antioxidants and improving cell viability. The mentioned research investigated hydrogen peroxide-induced cytotoxicity in H9C2 cells.

- **Neuroprotective Properties**

The therapeutic potential of dipeptidyl peptidase-4 (DPP-4) inhibitors in the treatment of Alzheimer's disease (AD) was confirmed in experimental studies Because phenolic compounds are known as DPP-4 inhibitors, Kosaraju et al. [2017] tested the neuroprotective effect of the jamun seed extract against the streptozotocin-induced AD in a rat model. The administration of jamun seed extract at doses of 200 and 400 mg/kg decreased amyloid load, tau phosphorylation and inflammation in the brain. Levels of tumor necrosis factor α (TNF-α) and interleukin-1β (IL-1β) in the hippocampus of rats from group treated with jamun seed extract was reduced when compared with a negative control group.

- **Anti-inflammatory Activity**

Due to the occurrence of several bioactive compounds, jamun seed powder or its extract can act as an anti-inflammatory agent, decreasing both acute and chronic inflammation. It was confirmed by several in vivo studies.

- **Antioxidant Activity**

The antioxidant potential of jamun seeds was analysed by several in vitro methods, using various techniques for the ex-traction of bioactive compounds. The phenolics (gallic acid, ellagic acid, ferulic acid, (+)-catechin, and quercetin) of seeds originated from underutilized indigenous black jamun land races found in the Gir forest region of India showed significant antiradical activity against DPPH.

- **FUTURE PROSPECTS**

The global prevalence of diabetes is increasing alarmingly, largely due to lifestyle changes. In 2019, 9.3% of the global population (463 million people) had diabetes, and this figure is projected to rise to 10.9% (700 million) by 2045. High costs and side effects of conventional anti-diabetic treatments have driven interest in herbal medicines.

A study on diabetic mice at Bangladesh Agricultural University evaluated the anti-diabetic effects of combined ethanolic extracts of Syzygium cumini (250 mg/kg) and Ficus racemosa (125 mg/kg), compared to their individual use. Results showed that the combined lower-dose treatment significantly reduced blood sugar levels (47.09% efficacy), outperforming S. cumini (36.89%) and F. racemosa (31.37%) used alone. Syzygium cumini demonstrated notable anti-diabetic activity, likely due to its ability to inhibit alpha-amylase and alpha-glucosidase enzymes, attributed to its high tannin content. However, further research is needed to explore its precise molecular mechanisms to develop effective herbal anti-diabetic treatments.

- **CONCLUSION**

In conclusion, Jamun (Syzygium cumini) seeds exhibit significant potential as a natural antidiabetic agent. Various studies have demonstrated their ability to regulate blood glucose levels through mechanisms such as enhancing insulin secretion, improving insulin sensitivity, and inhibiting key enzymes involved in carbohydrate metabolism. The seeds are rich in bioactive compounds like flavonoids, alkaloids, and tannins, which contribute to their antidiabetic properties. Furthermore, their antioxidant activity helps mitigate oxidative stress, a common complication in diabetes.

However, despite promising findings, more extensive clinical trials and studies are required to validate their efficacy and safety in humans. Additionally, standardized extraction methods and dosage formulations should be developed to ensure consistency and effectiveness. Jamun seeds, therefore, hold great promise as a complementary treatment for diabetes, but further research is essential for their integration into mainstream therapeutic approaches.

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