INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD)
© 2026 IJNRD | Volume 11, Issue 7, July 2026 | ISSN: 2456-4184 | IJNRD.ORG

A REVIEW ON : TRANSLATIONAL PRESPECTIVES ON SYZYGIUM CUMINI SEED POWDER IN THE MANAGEMENT OF DIABETES MELLITUS

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ABSTARCT:

Diabetes mellitus is characterized as a disorder of metabolism with chronic hyperglycemia due to the deficiency of insulin secreting cells or insulin resistance or by both. Despite the existence of traditional antidiabetic drugs, use of herbal based drugs is on rise because of advantages of natural products such as cost effectiveness, easy accessibility and lesser side effects. Traditional medicine has used black jamun seeds (Syzygium cumini) that contain various bioactive phytochemicals that exhibit antidiabetic properties. The seed powder contains jamboline, ellagic acid, gallic acid, flavonoids, tannins and alkaloids a phenolic antioxidant that could facilitate an improved glucose metabolism. These ingredients are reported to inhibit postprandial glucose levels, increase insulin activity, prevent oxidative damage in pancreatic β-cells, and enhance antioxidant status. In addition, it is suggested that jamun seed powder may not only contribute in responding to the oxidative stress in diabetic complications but also in preventing or delaying the development of such complications. Based on experimental and clinical evidence, it is suggested that the black jamun seed powder may be taken with proper diet and lifestyle modifications for glycemic control on regular basis. Nevertheless, owing to variations in preparation methods, dose and study design, larger and well-controlled clinical studies are required to establish standardized therapeutic recommendations. In summary, black jamun seed powder is an effective natural anti-diabetic agent, and further investigation on it for long-term efficacy and safety is warranted.

KEYWORDS:

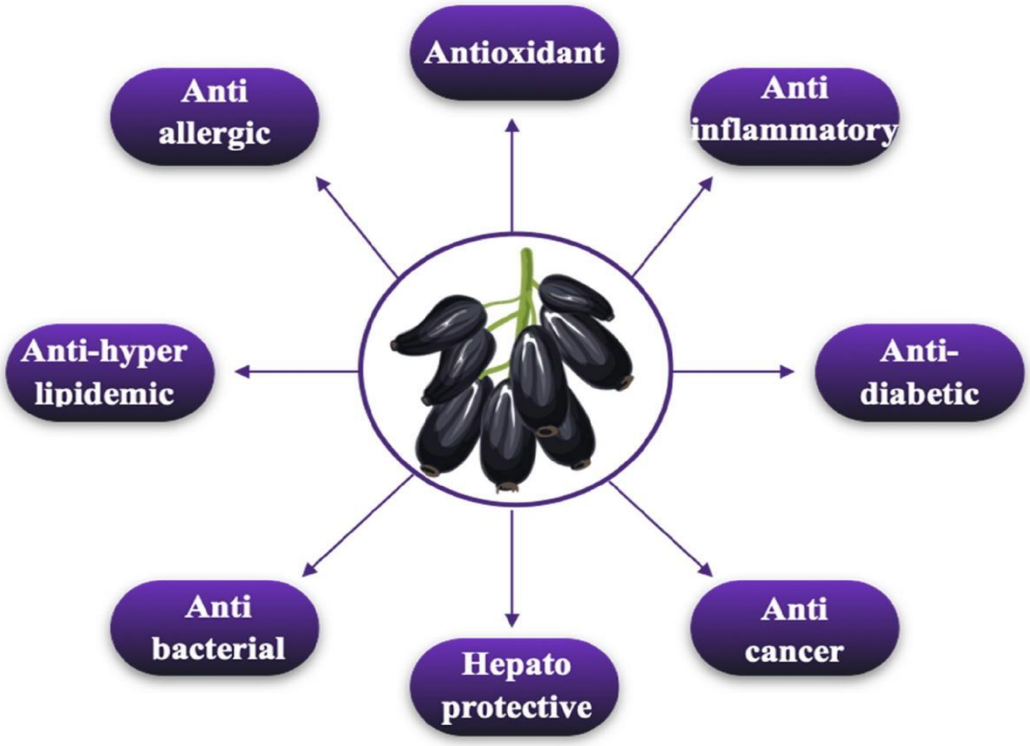
Syzygium cumini, Black jamun seed powder, Diabetes mellitus, Antidiabetic activity, Phytochemicals, Oxidative stress

1. INTRODUCTION:

Jamun (Syzygium cumini) is a potent natural resource of various bioactive compounds including flavonoids, polyphenols, antioxidants, iron and vitamin C. It is a tropical evergreen flowering tree of the myrtle family, the fruit of which is an integral component of traditional Indian medicine (Ayurveda) and other native medicinal practices around the globe. Jamun is mainly grown in the South Asian countries, namely India, Pakistan, Sri Lanka and Bangladesh (Bhakshu et al., 2022; Syama, 2017; Rizvi et al., 2022) [1,2,3]

The fruit is oblong to ellipse in shape and the size ranges from about 1.5 to 3.5 cm. It is dark purple to almost black in color, sweet, juicy and fleshy with a very distinctive sweet with a slightly astringent flavor.

One fruit has a single big seed (Kumar and Singh, 2021) [4] Despite the fact that the fruit is so delicious that it is much loved, in traditional medicine (Arooj et al. 2025) [5]



Food fortification is a process of increasing the nutritional value of staple foods through the addition of essential micronutrients, which enables them to be consumed by a larger population, particularly those vulnerable to under-nutrition.3) In this regard, jamun seed powder is gaining traction as a functional component and is now included in a variety of food products to enhance their nutritional value (Nagar et al., 2025) [6]

Calcium (8.3–15 mg), magnesium (35 mg), phosphorus (15–16.2 mg), iron (1.2–1.62 mg), sodium (26.2 mg), potassium (55 mg), copper (0.23 mg), sulfur (13 mg) and chlorine (8 mg) are the necessary mineral components of the nutritional value of jamun fruit (100 g of edible portion). The macronutrients of jamun (per 100 g of edible portion) includes moisture (83.7–85.8%), protein (0.7–0.129 g), fat (0.15–0.3 g), crude fiber (0.3–0.9 g), carbohydrate (14 g), and ash (0. 32–0.4 g). The fruit is also a source of 80 IU vitamin A,10(b) 0.008–0.03 mg thiamine, 0.009–0.01 mg riboflavin, 0.2–0. 29 mg niacin, 5.7–18 mg ascorbic acid, 7 mg choline, and 3 µg folic acid (Safdar and Khan, 2006) [7]. Syzygium cumini seed powder (D) Finely powdered Syzygium cumini seeds are dry.

1.1 PLANT PROFILE

- Botanical name: Syzygium cumini (L.) Skeels.
- Vernacular names**:** *Syzygium cumini* is widely known by the names Jamun, Java plum, Black plum, and Indian blackberry.
- Synonyms: Eugenia jambolana, Syzygium jambolanum.
- Family: Myrtaceae .

1.2. TAXONOMIC HIERARCHY

• Kingdom: Plantae

• Phylum: Angiosperms

• Order: Myrtales

• Family: Myrtaceae

• Genus: Syzygium

• Species: Syzygium cumini (L.) Skeels (Maurya and Tandel, 2025) [8].

Syzygium is a genus of over 1,000 species belonging mainly in tropical and subtropical regions of the globe. Genus members are widely recognized by their edible fruits, fragrant leaves, and medicinal properties. One of these species, Syzygium cumini, has been the subject of a large number of studies due to its high nutritional content and diverse therapeutic applications. In terms of taxonomy, the species was earlier placed under the genus Eugenia and was known as Eugenia jambolana. Later people to botanically revise it put it in Syzygium, the accepted scientific name is Syzygium cumini (L.) Skeels.This is on the basis of its floral character, fruit form and also on the molecular phylogenetic studies among closely related species within the Myrtaceae, which separates it.

The concept of "Food as Medicine" is an ancient one and is now more widely becoming accepted under scientific goggles. Today, it is proven that many of the plant foods are with extraordinary medicinal properties in addition to being a complete food. It has been shown that the diet and active or bioavailability non nutrient components of plants can contribute to the prevention and treatment of chronic and metabolic diseases such as diabetes mellitus, cardiovascular disease, cancer, cataract, gastrointestinal diseases, oxidative stress, central nervous system disorders, allergic diseases, bacterial infections, and cardiac disorders, among others. These therapeutic effects are attributed to their antioxidant, antiulcerogenic, antiprotozoal, antidiabetic, antiallergic, cardioprotective and central nervous system depressant properties (Banu and Jyothi, 2016; Kumar and Singh, 2021; Hemavathi et al., 2024) [9,4,10]

A complex metabolic disease diabetes mellitus (DM) is a consequence of impaired insulin secretion, insulin action, or both and is marked by abnormal carbohydrate, fat, and protein metabolism. The hallmark for this disease is persistent hyperglycemia, which results in many chronic complications. Of these, diabetic patients have an increased rate of vascular complications, and this is the major cause of their morbidity and

mortality, primarily because of chronic hyperglycaemia (Sidana et al., 2017; Meharban, A. , 2021; Kumar et al., 2023) [11,12]. Diabetes had been called the second highest fatal disease for humans across all diseases. Diabetes is also linked to insulin resistance, dyslipidaemia, hypertension and central obesity, which significantly increase the risk of cardiovascular problems, as per the World Health Organisation (WHO), (Rizvi et al., 2022) [13]

Diabetes mellitus is a global epidemic that is escalating in pandemic proportion. The global diabetic population was anticipated to rise to more than 300 million by 2025. India presently has the maximum number of people living with Diabetes across the globe. In addition, Bangladesh, Pakistan, India, Indonesia and China would be the top ten countries having the largest number of Diabetes populace by 2030. Just under 230 million individuals are affected by Type 2 Diabetes Mellitus (T2DM) globally, which accounts for ~6% of the adult population (Imran et al., 2022) [14] As per International Diabetes Federation (IDF) diabetes atlas, there are about 537 million adults (20–79 years) who are living with diabetes globally, with around 90% of them suffer from T2DM. Also, metabolic diseases such as diabetes mellitus and hyperlipidaemia have become epidemic and are considered as major global public health problems (Ni et al., 2022; Gaurav et al., 2025) [15,16]

The increasing prevalence of diabetes and the potential of plant-based drugs have prompted this review on the possible antidiabetic activity of Syzygium cumini (Jamun) seed powder for the treatment of Type 2 Diabetes Mellitus (T2DM). In this review,we discuss the scientific knowledge about its impact on glycaemic control, insulin sensitivity and metabolic control. It also covers the major phytochemical principles responsible for its pharmacological activities and discusses possible mechanisms of action for antidiabetic properties of the plant and existing scientific gaps that needs to be addressed for further experimental and clinical evaluation.

2.METHODS

A systematic review was undertaken to assess the impact of Syzygium cumini (Jamun) seed powder on glycaemic control and insulin sensitivity in individuals with Type 2 Diabetes Mellitus (T2DM). Studies were searched using date limits = 2006 to 2025 on bases of PubMed, Google Scholar, ScienceDirect and Scopus. Literature search A literature search was conducted using the following keywords: Jamun seed powder, Syzygium cumini, antidiabetic activity, glycaemic control, and insulin sensitivity. Criteria for inclusion were peer-reviewed scientific research articles consisting of animal studies, clinical trials, phytochemical studies, and review articles related to Jamun seeds and diabetes. Studies not related to diabetic outcomes, duplicate publications, and articles not written in English were excluded from the review. A total of 140 records were identified initially. After title screening, assessment of abstracts, and evaluation of full-text articles for eligibility, 40 studies met the criteria for inclusion and were included in the review. Data for phytochemical content, dose, study design, fasting plasma glucose (FPG), postprandial glucose (PPG), glycated haemoglobin (HbA1c), insulin resistance, antioxidant activity were extracted and subjected to descriptive analysis.

3.NUTRITIONAL PROSPECTS OF JAMUN SEEDS

Syzygium cumini seeds have a plethora of nutritional and bioactives compounds, which pave the way for its high medicinal and therapeutic importance. They have 6.3–8.5% protein, 1.18% fat, 16.9% crude fibre, 21.72% ash and 8.2% moisture. They are a source of vital minerals including calcium (0.41%) and phosphate (0.17%) from seeds. They are also laden with carbohydrates, starch making up 40.99% and dextrin 6.1%, which makes a starch reserve and is one of the factors that contribute to they nutritional value (Sood et al., 2018; Marufa et al., 2019) [17,18].

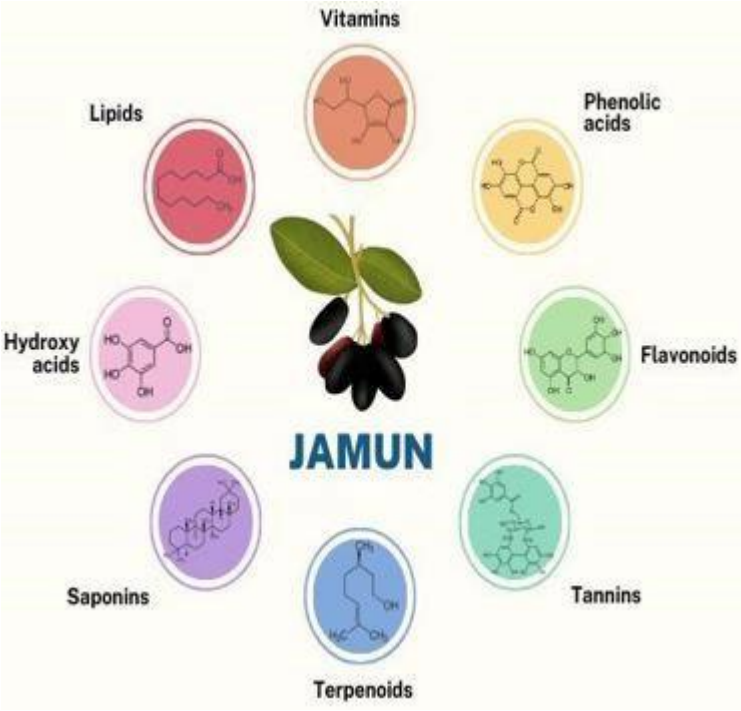
3.1 Fatty Acids and Fatty Oils

The most numerous ones are oleic acid 32.2% and myristic acid 31.7%. Small amounts of phytosterols such as β-sitosterol are also present in the seed along with large quantities of tannins (6–19%) in the form of corilagin, ellagitannins, ellagic acid, galloyl-galactosidase and gallic acid. These phytochemicals are largely responsible for the antioxidant, antidiabetic and other several pharmacological activities of jamun seed (Rai, 2003; Sood et al. , 2018; Marufa et al., 2019) [17,18]

4.BIOACTIVE COMPONENTS OF JAMUN

Jamun is renowned for its nutritional and therapeutic quality as a result of the presence of multitude of bioactive compounds and polyphenols. Its phytochemical composition is enriched with alkaloids, anthocyanins, tannins, cardiac glycosides, flavonoids, phenols, terpenoids, glycosides, steroids, saponins, reducing sugars, proanthocyanidins, amino acids and phytosterols. These secondary metabolites also contribute the multifarious medicinal properties and that whole of this potential entities of jamun (Mulkalwar et al., 2021; Jagetia, 2024) [19,20] The active bio constituents present in jamun have a range of physiological activities like hypoglycemic, anti-inflammation, antibacterial, antiviral and neuroprotective (Singh et al., 2019) [21]

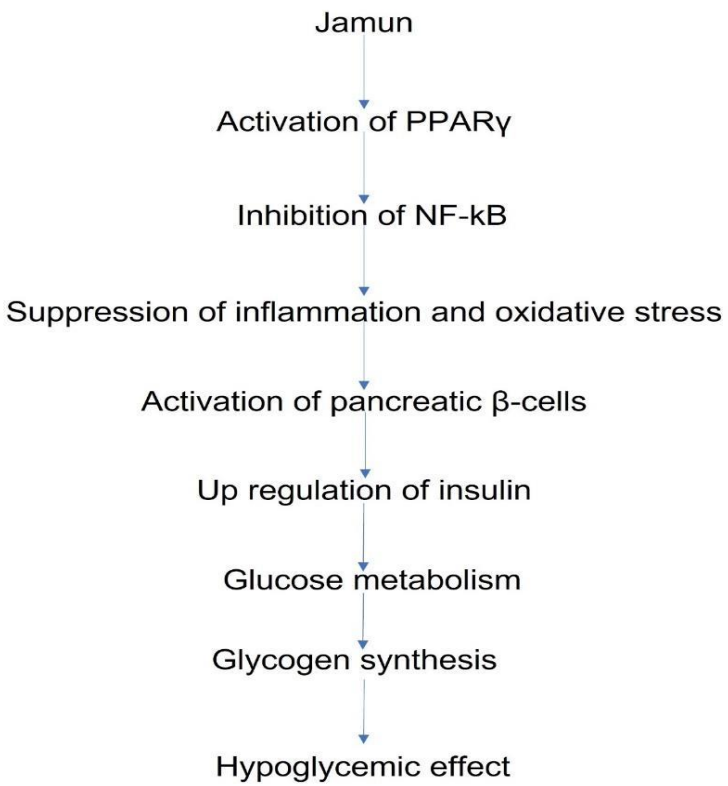
Jamun (Sonneratia apetala Smith) seed oil: A review of extraction, physicochemical, phytochemical, and medicinal value Among the fruit parts, jamun seeds have a greatest medico value. Traditionally, they have been employed or used to treat diabetes, allergic diseases, viral diseases, inflammatory diseases, and stomach ulcers. Furthermore, the seeds of jamun possess various pharmacological activities including antidiuretic, antinociceptive, hypothermic, chemoprotective and cardiopretective. Due to the presence of numerous bioactive phytochemicals jamun seed is the interesting natural source for prevention and cure of cardiometabolic disorder (Kumar et al., 2022) [22]



5.JAMUN SEEDS COMBAT DIABETES

Syzygium cumini (Jamun) has long been known for its therapeutic value especially as an antidiabetic agent. It harbors numerous bioactive compounds like flavonoids, terpenes, anthocyanins, glycosides, jambolin and ellagic acid, which contribute to its medicinal value. The use of jamun for controlling diabetes is older than the discovery of insulin and the articulated application of jamun for diabetes in Ayurveda and traditional Indian medicine (Asanaliar and Nadig, 2020) [23]. Consequently, these phytocompounds make jamun a viable natural candidate to be explored in the hunt for a medicine against diabetes.

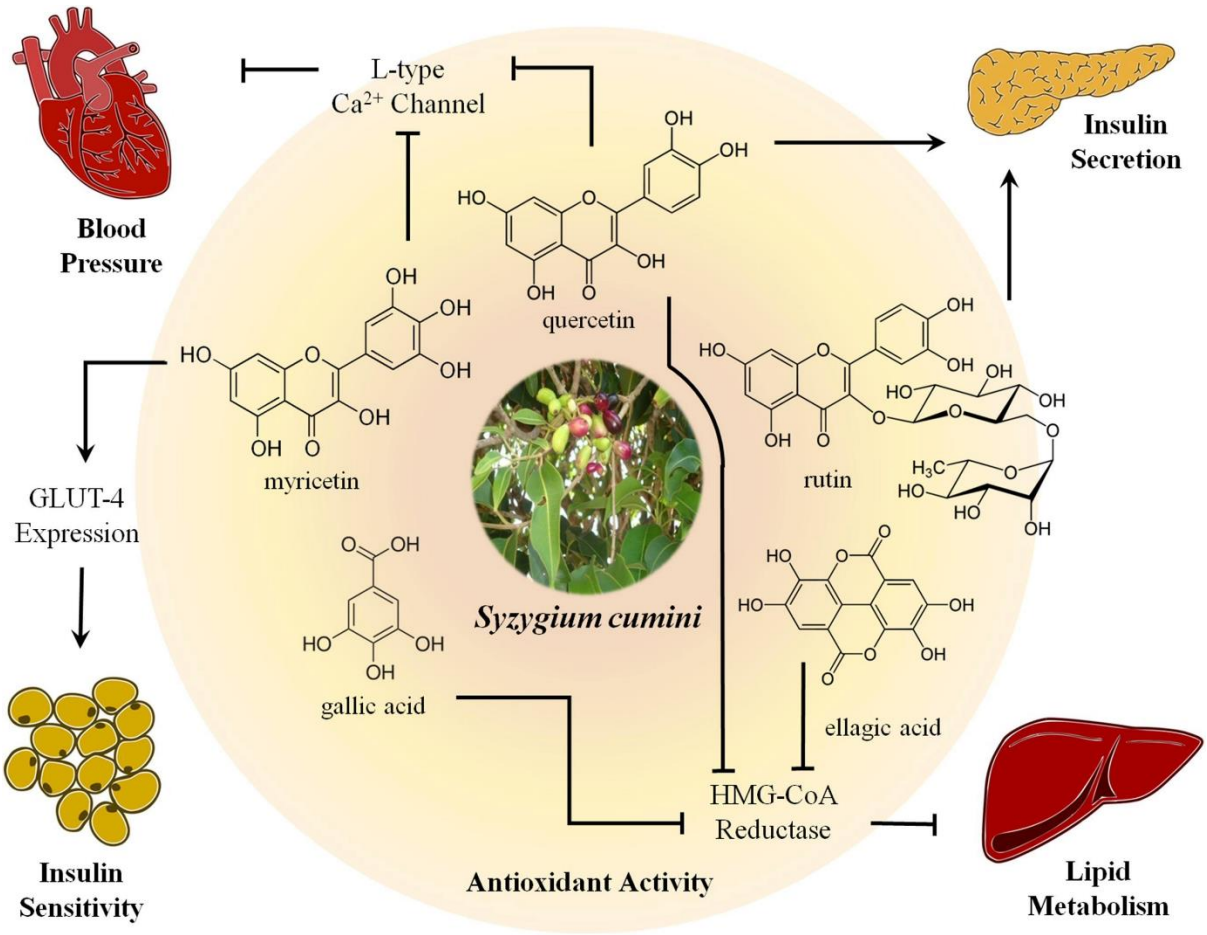
Diabetes mellitus has been an epidemic across the globe and developing nations bearing a huge burden due to its rising prevalence among the urban and rural population. Disease management is made more difficult by factors including poor public knowledge, insufficient healthcare facilities, and the expense of standard care. Although synthetic antidiabetic drugs are most commonly prescribed, they come with numerous adverse side effects. Therefore, medicinal plants are widely being considered as safer, more effective, and natural means to prevent and treat diabetes (Yedjou et al., 2023; Saini et al, 202 5) [24 25] Moreover, the adoption of healthy diet, regular physical activity, routine health screening, and improvement of public awareness are considered to be key strategies in the prevention of diabetes, and in the reduction of its long term complications (Ramachandran, 2014; Kaur et al., 2025) [26,27]



Both the pulp and seeds of the jamun have shown excellent antidiabetic activity. The glycosides present in the seeds are also said to have an important role in lowering blood glucose levels as well as it is said to protect against development of diabetes related complications such as neuropathy and cataracts (Baliga et al., 2013; Amin, 2020)[28]Additionally, active compounds like Jambolin and ellagic acid are said to prevent the conversion of starch into glucose excessively and thus contributes on keeping the blood sugar under control (Singh et al., 2019; Mitra, 2007; Amin, 2020)[29]The metabolism of carbohydrates is further enhanced by the presence of polyphenolic compounds in jamun seed powder (JSP), which encourages the conversion of starch to energy. This process helps to control the level of glucose in the blood and may also alleviate some of the frequent symptoms of diabetes such as having to drink too much water or going too often to the

bathroom (Ayenampudi et al., 2023) [30] Given the above-mentioned good features of jamun, it is a promising natural therapeutic candidate for type 2 diabetes management.

Some in vitro and in vivo experiments have revealed the antidiabetic property of the extracts of jamun seeds. Pure substances like mycaminose and the ethyl acetate and methanol extracts from the seed kernels of Syzygium cumini exhibited a significant hypoglycaemic activity in streptozotocin diabetic rats (Rather et al. (2019) [31] and Neha et al. (2015) [32]. The hypoglycemic action of mycaminose was found at 50 mg/kg while, the jamun seed kernel extracts exhibited significant antidiabetic potential at 400 and 200 mg/kg.



This points to even more therapeutic worth of the bioactive ingredients of jamun seeds.

The anti-diabetic potential of jamun has also been validated by clinical trials. FPG was reduced by 9%, 18%, and 30% in the treatment group reported by according to Sidana et al. (2017) [11] after 30, 60 and 90 days of treatment, respectively. In the same treatment periods, postprandial plasma glucose (PP glucose) was also reduced by 8%, 15%, and 22%. In addition, the HbA1c levels of the treatment group were significantly decreased from 8.99±1.39% to 8.31±1.40% at term 90 days while a marginal increase was found in the control group. These results demonstrate that jamun supplementation may safely enhance glycaemic control in diabetic patients.

6.JAMUN AS AN ANTIHYPERLIPIDEMIC AGENT – A REVIEW

Hyperlipidaemia is a metabolic abnormality that is commonly found in patients with diabetes and greatly contributes to the progression of cardiovascular diseases. Lipid lowering property of Syzygium cumini (Jamun) was proved in few studies. The fruit as well as seed extracts have shown to possess significant hypocholesterolaemic activity by reducing the levels ofs total cholesterol, low-density lipoproteins, very-low-density lipoproteins and triglycerides and enhancing the levels of high-density lipoprotein in different animal models (Rekha et al., 2010; Raza et al., 2017) [33, 2]. Identical outcomes were also reported in alloxan- and streptozotocin-induced diabetic animal models, in which jamun supplementation lowered the activity of the rate limiting enzyme of cholesterol synthesis, HMG-CoA reductase (Siddiqui et al., 2014) [34].

Moreover, both aqueous and ethanolic extracts of jamun were found to exert mild significant antihyperlipidaemic activity in high-cholesterol diet induced cystathionine-β-synthase deficient rats (Sharma et al., 2011) [35]. The above mentioned finding is also corroborated by evidence from human studies, wherein treatment of subjects with jamun seed powder for a duration of 60 days led to a marked reduction in the blood cholesterol level (Jagetia, 2018) [36]. Taken together, the results indicate the potential of jamun as a natural lipid improving agent.

7.RECOMMENDATION

Based on evidences present, Syzygium cumini (Jamun) Seed Powder possesses a potential SS be a natural adjuvant in the treatment of Type 2 Diabetes Mellitus due to the antihyperglycaemic, antioxidant and insulin-sensitizing activities (Mulkalwar et al., 2021; Sidana et al., 2017) [32,11]. Present result suggests that jamun seed powder could be used as a functional food supplement/dietary supplement for improving glycaemic control by lowering blood fasting, blood postprandial glucose, and metabolic health in general (Amin, 2020; Kumar et al., 2022; Rizvi et al., 2022) [22,3].

Besides that, it might be employed as an adjuvant dietary treatment with traditional antidiabetic drugs in particular in people with prediabetes or in the early T2DM stage (Yedjou et al., 2023; Saini et al., 2025) [24,25]. However, the currently available evidence is not enough and more such high quality trials investigating optimal dose, long-term safety and therapeutic effectiveness of jamun seed powder are required to confirm the findings of this review, thus it cannot be recommended for general clinical use (Bhakshu et al., 2022; Ni et al., 2022) [1,15].

CONCLUSION

The result of this review suggests that seed powder of Syzygium cumini (Jamun) could be a promising natural therapeutic candidate for the treatment of Type 2 Diabetes Mellitus. They are a good source of bioactive compounds (flavonoids, polyphenols, tannins, glycosides, and anthocyanins), which are responsible for their antihyperglycaemic, antioxidant, and insulin-sensitizing activity. Studies based on animal models as well as human trials have established the efficacy of jamun seed powder in bringing down FBG, PPBG, and glycated haemoglobin (HbA1c) levels in addition to improving insulin sensitivity and the functioning of pancreatic β-cell. Furthermore, by reducing oxidative stress and serum lipid levels, it could potentially be used to prevent diabetes-associated complications. With these advantageous functions Syzygium cumini seed powder can be used as a cheap natural adjuvant to control glycaemia in Type 2 Diabetes Mellitus The developing world is experiencing a rise in individual with Type 2 Diabetes Mellitus, Syzygium cumini can prove much a vital as well as cheap aid to manage this. Nevertheless, the promising results call for well-designed, large-scale and high-quality clinical trials to verify its safety, efficacy and future possibility in clinical use.

Black Jamun seed powder (Syzygium cumini) is an emerging natural therapeutic due to the presence of potent bioactive compounds such as flavonoids, polyphenols, alkaloids, tannins, ellagic acid, gallic acid, and

jamboline with beneficial effects for the management of diabetes mellitus. These phytochemicals affect several antidiabetic pathways, including lowering blood glucose, enhancing insulin sensitivity, acting as antioxidants, suppressing enzymes that break down carbohydrates, and shielding pancreatic β-cells from harm. Besides its hypoglycemic effect, black jamun seed powder has also shown to possess antioxidant, anti-inflammatory and anti-hyperlipidemic activities which may contribute in preventing or delaying complications associated with the diabetic condition such as cardiovascular and renal diseases.

There are Incessant and escalating needs for novel safe and effective therapeutic strategies to treat and prevent diabetes mellitus. In the line of medicinal plants used for diabetes management, black Jamun (Syzgium cumini seed powder)has drawn more attention because of its wide spectrum of pharmacological properties and traditional consumable use value. These seeds also contain several bioactive components like flavonoids, phenolic compounds, tannins, alkaloids, ellagic acid, gallic acid, anthocyanins and jamboline which are largely responsible for their antidiabetic activity. In-vitro, in-vivo, and clinical studies have established that black seed (Nigella sativa) powder acts as a blood glucose regulator through multiple mechanisms such as stimulation of insulin secretion and sensitivity, inhibition of carbohydrate- digesting enzymes in the intestine, decreased glucose uptake, β-cell protection in the pancreas, and modification of the antioxidant defense system. Its antioxidant, antiinflammatory and antihyperlipidemic effects additionally contribute in lowering the risk of complications associated with diabetes like cardiovascular disease, nephropathy, neuropathy and retinopathy.

Moreover, its therapeutic potential is further amplified due to the presence of vital nutrients and phytochemicals that promote better metabolic health. Although these results are promising, application of black jamun seed powder in clinical practice is hindered due to lack of standardization among cultivation conditions, phytochemical compositions, processing methods, dosages, and formulations. Hence, in the light of current evidence, research should be directed to the appropriate randomized controlled trials, active principle(s) isolation, pharmacokinetics studies, safety evaluation, and to the preparation of standardized formulations able to guarantee consistent therapeutic effects.

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