

## Review of *Syzygium cumini* (L.) Skeels' phytochemical components and traditional applications

Akanksha S. Tompe\*, P. D. Makne, Dr. S. S. Patil, Sumit Sontakke, Shweta Patil.

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### ABSTRACT

Jambolan is a coloured fruit from the Myrtaceae family and the Syzygieae tribe that ranges in colour from yellowish-green to black. This article offers a broad perspective on the nutritional and health benefits, as well as the advantages of the primary jambolan fruit ingredients. The fruit's colour and high sugar content have caught the attention of the culinary sector. Particularly the levels of anthocyanins, which tend to rise from 28.5 to 1318.4 mg/100 g throughout ripening, stood out among phytochemical concentrations. The pulp and peel of *Syzygium cumini* (L.) Skeels contain delphinidin, cyanidin, petunidin, peonidin, and malvidin, according to studies. There have been claims that the fruit contains lutein, zeaxanthin, beta-carotene, and beta-cryptoxanthin. The first study to suggest a potential carotenoid production pathway in *S. cumini* using the data at hand was this one. Furthermore, numerous research have linked *S. cumini* ingestion to antidiabetic, hypolipidemic, antioxidant, and hepatoprotective properties. (1)

### I. INTRODUCTION

Specifically native to tropical America and Australia, the genus *Syzygium* is one of the genera of the myrtle family Myrtaceae. Its distribution in tropical and subtropical areas is global, despite being incredibly uneven. About 1100 species make up the genus, and its native range stretches | | from southern Asia east to the Pacific to Africa and Madagascar. It has long been valued for both its great nutritional content and therapeutic properties. It has a variety of pharmacological effects, and different parts of the plant, including the bark, leaves, seeds, and fruit, have been used medicinally to treat a number of ailments. Health organisations from throughout the world endorse *Syzygium cumini* as a secure medication for treating a number of diseases.(5) Since more than fifty years ago, numerous

countries have employed this plant in homoeopathic practises for the treatment and prevention of various diseases. In particular, this plant promotes weight restoration, reduces excessive blood glucose levels, and improves the activity of antioxidant enzymes including catalase, peroxidase, and super oxide dismutase. (6)

### Botanical Description and Taxonomy

An evergreen tree with grayish-white stems and coarse, discoloured bottom bark, *Syzygium cumini* can reach heights of up to 25 metres (80 ft). The leaves are straightforward, opposite, elliptic to oblong, smooth, shiny, and somewhat leathery.

The leaves have a noticeable, golden midrib, (10). In addition, the leaves are 2 to 8 centimetres in width and 5 to 15 centimetres in length. Edges are toothed, the base is cuneate or round, the apex is short, rounded, or obtuse, the stalk is thin and light yellow, and the veins are fine, closely spaced, parallel, and glandularly spotted(11).

The flowers have four petals and several stamens and are white to pinkish, measuring about 1 centimetre (0.5 inch) across (10). The calyx is cup-shaped, 4 millimetres long, and tooted. The petals stick together and drop as a single tiny disc. Numerous and nearly the same length as the calyx are the stamens(8)

The fruits are glossy, ovoid, 1-seeded, dark purple red, and have white to lavender flesh. They measure 2 centimetres (0.8 inch) in length (10). The fruit is described as being oval to elliptic in shape, 1.5 to 3.5 centimetres in length, and dark purple to black in colour in the Philippines . The fruit tends to turn the tongue purple and has a flavour that combines sweetness, mild sourness, and astringency. Additionally, the fruit's rich violet hue creates the appearance that it is an olive tree fruit because of its weight and shape(8).



**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:** *Syzygium cumini* (3)

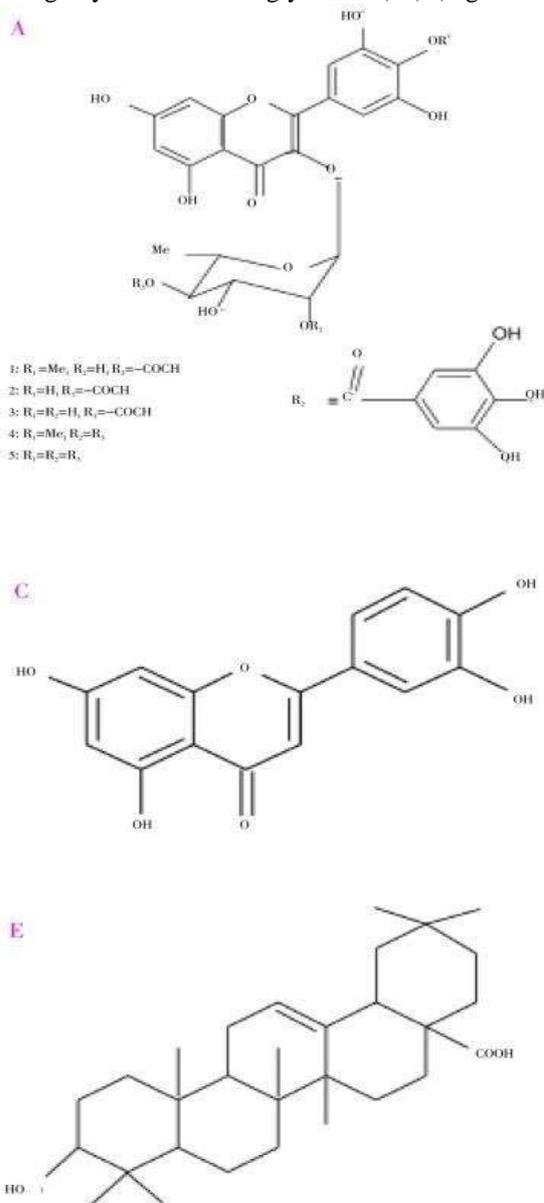
#### Phytochemical Constituents-

Jambolan is abundant in substances that contain anthocyanins, glucoside, ellagic acid, isoquercetin, kaemferol, and myrecetin. The seeds are said to contain the alkaloid jambosine and glycoside jambolin or antimellin, which prevents the diastatic conversion of starch into sugar. Seed extract has been shown to lower blood pressure by 34.6%, and this effect is ascribed to the presence of ellagic acid.(12)The seeds have been discovered to have high levels of total phenolics with significant antioxidant activity,(13) as well as being relatively rich in calcium and protein. Flavonoids, a well-known antioxidant, are responsible for the

scavenging of free radicals and protective effects on antioxidant enzymes. Java plums are abundant in sugar, mineral salts, vitamin C, PP, anthocyanins, and flavonoids. (15)

### Leaves-

The leaves contain a variety of compounds, including acylated flavonol glycosides(16) (Figure



1A), quercetin, myricetin, myricitin, myricetin 3-O-4-acetyl-L-rhamnopyranoside(17) (Figure 1B), triterpenoids(18), esterase, galloyl carboxylase(19), and tannin. (20)

### Stem bark-

The stem bark contains significant amounts of betulinic acid, friedelin, epi-friedelanol, -sitosterol, eugenin, kaempferol, myricetin, gallic acid(21), and ellagic acid(22), as well as bergenins, flavonoids, tannins, and -sitosterol(23) (Figures 1C

and 1D). The astringent nature of stem bark may be brought on by the presence of gallo- and ellagi-tannins. (24)

### Flowers-

The flowers are abundant in kaempferol, quercetin, myricetin, isoquercetin (quercetin-3glucoside), myricetin-3-L-arabinoside, quercetin-3-D-galactoside, dihydromyricetin, oleanolic acid (Figure 1E), acetyl oleanolic acid, eugenol-triterpenoid A, and eugenol-triterpenoid B (25)

### Roots-

The roots contain significant amounts of isorhamnetin 3-O-rutinoside(26) and flavonoid glycosides.(27)

### Fruits-

The fruits include high levels of raffinose, glucose, fructose(28), malic acid, gallic acid(29), anthocyanins(30), delphinidin-3-gentiobioside, malvidin-3-laminaribioside(32), petunidin-3-gentiobioside, and cyanidin diglycoside(31). Fruits' sourness may be caused by the presence of gallic acid. It's possible that anthocyanins are what gives the fruits their color(33). The fruit's nutritional composition is as follows: 83.70–85.80 g moisture, 0.70–0.13 g protein, 0.15–0.30 g fat, 0.30–0.90 g crude fibre, 14.00 g carbohydrate, 0.32–0.40 g ash, 8.30–15.00 mg calcium, 35.00 mg magnesium, 15.00–16.20 mg phosphorus, 1.20–1.62 mg iron, 26.20 mg sodium, 55.00 mg potassium, (34)Vitamin A, 0.01-0.03 mg thiamine, 0.009-0.01 mg riboflavin, 0.20-0.29 mg niacin, 5.70-18.00 mg ascorbic acid, 7.00 mg choline, and 3.00 mcg folic acid are all included in each serving. (35)

### Essential oils-

The essential oils isolated from the freshly collected leaf (which account for 82% of the oil), stem, seed, and fruits contain -Pinene, camphene, -Pinene, myrcene, limonene, cis-Ocimene, trans-Ocimene, terpinene, terpinolene, bornyl acetate, copaene, -Caryophyllene, Additionally, chemical research was done on the seed fat's unsaponifiable components.(36)

### Medicinal properties and health benefits-

1. Jamun, its medicinal properties and health benefits
2. Jamun and its antioxidant properties
3. Jamun and its anti-inflammatory properties
4. Jamun and its anti-diabetic properties
5. Jamun, its anti-microbial and anti-bacterial properties
6. Jamun and its anti-cancer properties (4)

### 1. Jamun, its medicinal properties and health benefits

In India and other nations, the Unani System of Medicine (USM) is practised as a kind of complementary, alternative, and traditional medicine. Since the beginning of time, this school of medicine has made considerable use of medicinal plants to treat a wide range of illnesses. One of the medicinal herbs, jamun (*Syzygium cumini* Linn), is used to treat diabetes mellitus, hemorrhagic and bilious diarrhoea, loss of appetite, dysentery, and oral ulcers. Recent experimental and clinical research have demonstrated the therapeutic potential of this plant's fruits, seeds, leaves, stem bark, and secondary metabolites. Review was done of the ethnobotanical applications and pharmacological effects of jamun and its seeds as they were documented in classical literature and scientific publications based on experimental research. It was discovered that this plant is crucial for the management and prevention of non-communicable diseases like heart disease, cancer, gout, diabetes, and others. It has been shown in several preclinical investigations to have anti-inflammatory, cardiac protecting, anti-pyretic, and hepatotonic effects. According to Ahmad, it also has anti-diabetic potential activity and is regarded as an effective anti-diabetic plant .

When the physicochemical, proximate, vitamins, and mineral makeup of jamun seed was examined, it was found to contain adequate levels of protein, fat, and a significant amount of vitamin C (ascorbic acid), as well as minerals (Iron, Calcium and Potassium). In order to create functional food items, jamun seeds can be used (38) . The therapeutic characteristics of jamun and its extract make it a healthy ingredient for routine consumption, as evidenced by the nutritional benefit of Indian blackberry biscuits in lowering the BMI and WHR among Type 2 diabetes (39) . The prevention and treatment of numerous ailments as well as the potential advantages of the main bioactive components found in jamun were studied. Myricetin, oxalic acid, gallic acid, citronellol,

cyanidin diglucoside, hotrienol, phytosterols, flavonoids, carotenoids, and polyphenols are some examples of these bioactive chemicals, which have been linked to a number of health advantages (40).

Due to its anti-diabetic and anti-ulcer properties, jamuns (*Eugenia jambolana* Lam.) are regarded as useful foods. The dried seed extract of *Eugenia jambolana* (EJE) is sold throughout the world as a component of multi-herbal diabetes treatments. For the better management of the chronic metabolic condition, it was observed that many patients took EJE as a home remedy in addition to the recommended course of oral hypoglycemics(41). The abundance of medicinal, pharmacological, anti-inflammatory, cardio-protective, antiviral, and hepato-protective properties found in jamun plant components lend credence to the fruit's reputation of being extremely healthy.

Utilizing fresh fruit can have great impacts, but using and consuming manufactured foods can also make favourable effects available. Studies have indicated that the bioactive substances found in jamun (*Syzygium cumini*) may be helpful in reducing a variety of ailments connected to the neurological system, gastrointestinal tract, and heart. The presence of flavonoids, terpenes, alkaloids, phenyl propanoids, tannins, and lipids is thought to be responsible for the pharmacological effects seen in jamun. The most significant pharmacological impact is the antidiabetic action. Strong pharmacological qualities of jamun demonstrate this traditional medicinal plant's abundance of bioactive chemicals, and studies must be conducted to advance phytochemical and clinical aspects for the development of safer medications that can be used for treating various human diseases. It demonstrates that jamun contains a variety of medicinally significant bioactive chemicals and supports their usage as a traditional remedy for the management of various disorders. Overall, it was discovered that jamun seeds help to control diabetes, cleanse the blood, control blood pressure, treat stomach-related issues, and aid in bodily detoxification. It maintains the body healthy and protects it from numerous ailments. Consuming jamun seeds might help regulate your blood sugar and ease stomach issues, among other things. Jamun seeds must be consumed in order to adequately hydrate the body. Jamun seeds are abundant in fibre, vitamins, minerals, and water. They are therefore quite helpful for keeping one's health in check.

## 2. Jamun and its antioxidant properties

Jamun or *Syzygium cumini* is also known as the Malabar plum, Java plum, or Black plum. The presence of antioxidants such as ascorbic acid, anthocyanins, and total phenols in jamun fruit has led to its recognition as a nutraceutical fruit. Antioxidants are substances that prevent oxidation. These substances aid in protecting our cells from oxidative stress brought on by free radicals, potentially dangerous chemicals(43), reviewed the confirmation of the high levels of phenolics present in the fruit, especially in the seeds of Jamun, and it contains the highest level of antioxidants, such as gallic acid, tannins, anthocyanin, glucoside, malvidin, and other components (aside from vitamin C), and TAA (total antioxidant activity), which is beneficial for those with hypertension and it also helps to regulate blood pressure. A thorough and succinct assessment of the clinical trials of antioxidative natural compounds from jamun seeds(44). They came to the conclusion that products made from jamun seed extracts are frequently thought to be safer, less expensive, more readily available, and occasionally even more effective than entirely synthetic medications. Blackberries are regarded as natural antioxidant sources, and the seeds contain significant amounts of antioxidants that have positive effects on both health and disease prevention. According to the study's findings(45), jamun seeds' abundance in resveratrol and other antioxidants may help prevent cancer and heart-related illnesses. This shows that there is a huge market opportunity for the creation of functional beverages. Other research has shown that jamun seeds have antioxidant qualities that are good for human health and treating several diseases such as diabetes, cancer, reduce risk of stroke and coronary diseases. Jamun are recognized as source of natural antioxidants and thus play an important role in the chemo prevention of diseases and aging.

## 3. Jamun and its anti-inflammatory properties

An ingredient or medication has the ability to reduce inflammation when it is anti-inflammatory. Antiinflammatory medications suppress inflammation, which helps them lessen pain. These medications can be used by patients to treat pain, stiffness, swelling, and fever symptoms. Anthocyanins, a type of antioxidant, are present in blackberries. These substances may lower inflammation, strengthen your immune system, and lower your risk of heart disease. Numerous human studies have looked into the effects of jamun, including its extracts and pure anthocyanins. The

goal of the review is to assess where human research stands in terms of blackberry (products) as a source of dietary polyphenols, particularly anthocyanins, to control inflammation. The risk of developing chronic diseases can be reduced and dietary recommendations for obtaining and maintaining health can be informed by discovering dietary tactics that control the contemporary inflammatory burden(46) . An ethanolic extract of *Syzygium cumini* seed has been shown to have anti-inflammatory properties against prostaglandin, histamine, and serotonin(47). The seeds of *S. cumini* exhibit anti-inflammatory activity that is particularly effective in lowering blood cholesterol and shares a molecular composition with cholesterol. (48)

Jamun contains polyphenols that have been linked to anti-inflammatory effects in people. Anthocyanins, the polyphenols that give blackberries their unique red, blue, and purple hues, are among the most notable of them. As a result, it was discovered that jamun seeds have anti-inflammatory qualities that are advantageous for preserving human health as well as in the treatment of heart disease, reduce inflammation, enhance immunity, and combat pain, stiffness, and lower cholesterol. The antioxidant capabilities of jamun seeds have been the subject of extensive research, although preliminary findings point to significant impacts on inflammatory pathways.

#### 4. Jamun and its anti-diabetic properties

The most prevalent endocrine illness is diabetes mellitus, which is accompanied by other metabolic syndromes. The WHO recommends using conventional medicine to manage diabetes. Alternative methods that have less adverse effects and are less expensive are being studied to lower blood glucose levels . Because it has been discovered to have anti-diabetic qualities, blackberries are one of the traditional plants that are used to cure diabetes in many different countries. All of the various medications used to treat diabetes are referred to as having anti-diabetic characteristics. All of these medications work to lessen ketoacidosis and excessive urine. Jamun has been used for a very long time as a traditional remedy and preventative measure for diabetes.

*S. cumini* seed powder has hypoglycemic properties. According to a report, it could become a viable candidate medicine for individuals with Type 2 Diabetes Mellitus who want to effectively regulate their blood sugar levels(49). Diabetes can be prevented by polyphenolic chemicals found in jamun seeds(50) . The seed aids in the conversion

of carbohydrates into energy and controls blood sugar levels. *S. cumini* and its extracts lessen diabetic symptoms including thirst and frequent urination. The oral administration of *E. jambolana* seed to streptozotocin-induced diabetic rats resulted in a hypoglycemic effect in 30 minutes, which was presumably caused by the stimulation of insulin secretion. The ethanolic extract of *S. cumini*, (52) , reduced blood sugar levels in rabbits that were overdosing on glucose by 20% after an hour. The use of jambul in the treatment of diabetes has been supported by a large number of other animal studies. As a result, it was noted that various writers used the extraction of *S. cumini* seeds in their studies to establish the jamun's anti-diabetic properties. The extract of *S. cumini* has a powerful amylase inhibitor with a higher degree of inhibition(53) . The findings revealed that *S. cumini* had potent anti-diabetic properties. The study also contributes to the understanding of *S. cumini*'s regional pharmacological value as a traditional diabetic treatment. The use of seed extracts in the treatment of diabetes is quite advantageous. According to various experts, jamun has been shown to have the most promising nutraceutical value and is well-known for its anti-diabetic properties.

#### 5. Jamun, its anti-microbial and anti-bacterial properties

An antimicrobial is a substance that either eliminates or inhibits the growth of microorganisms. Antimicrobial drugs can be divided into categories based on the microorganisms they are most effective against. As an illustration, antibiotics are used to treat bacteria, whereas antifungals are used to treat fungi. *Syzygium cumini* seed extracts can be used to treat skin wounds since they have antibacterial and antifungal action against some microorganisms(54) . Monoterpene aldehydes are assumed to be the cause of the antibacterial action seen in *S. cumini*. Additionally, it has been suggested that the fruits contain additional bioactive substances like citric, malic, and gallic acid as well as phytochemicals like anthocyanins, alkaloids, carotenoids, flavonoids, polyphenols, and tannins that are also known to be effective and actively participate in the body's defence against a variety of infectious agents. Thus, the research demonstrates that *Syzygium cumini* (jamun) seeds have a significant antibacterial activity potential (55) . When *S. cumini* seed methanol extracts were examined for antibacterial efficacy and toxicity, it was discovered that the extracts suppress bacterial

growth. The phyto-chemical analysis and spasmolytic activity of the hydro alcoholic extract derived from *S. cumini* were both examined in a study(56).

The seeds' spasmolytic, antibacterial, and anti-diarrheal properties were combined, demonstrating that they share the same secondary metabolites, suggesting that they may be used to treat colic and/or diarrhoea. It was effectively demonstrated that *S. cumini* extract has *in vitro* anti-bacterial activity(57). This activity can be used to assess the toxicity and the optimum dose to be employed as effective, and it can be compared to the activity of typical antibiotics. The folkloric use of this species to treat infectious diseases stimulated the investigation of the antimicrobial activity of the hydroalcoholic extract from seeds and leaves against standard and multi drug resistant Gram-positive and Gram-negative human pathogenic bacteria(58). When *Eugenia jambolana* seeds were not used as food by the populace and were thrown away as garbage. The antibacterial activity of the *E. jambolana* seed extracts against six gram-negative (*Escherichia coli*, *Salmonella typhi*, *Salmonella paratyphi A*, *Salmonella paratyphi B*, *Pseudomonas aeruginosa*, and *Proteus vulgaris*) and four gram-positive (*Staphylococcus aureus*, *Bacillus subtilis*, *Bacillus cereus*, and *Bacillus megaterium*) According to a preliminary analysis of the various solvent extracts of jamun, aqueous and ethanolic extracts demonstrated significantly higher antibacterial activity than acetic acid and petroleum ether extracts did against the tested microorganisms. Jamun seeds are therefore a possible source of antibacterial compounds.

Consequently, a number of studies have been carried out, and it can be said that *S. cumini* and its extracts from seeds and other parts have significant anti-microbial activity. The extracts can offer affordable and sustainable methods to ward off disease reduction and can eventually improve the quality and peri-urban in developing countries.

#### 6. Jamun and its anti-cancer properties

Cancer is the unchecked expansion of aberrant cells in the body, which results in the formation of tumours, or masses of tissues. When the body's regular regulating mechanism breaks down, the old cells proliferate out of control and give rise to new, aberrant cells rather than dying. The second leading cause of death in humans, behind cardiovascular disease, is a non-communicable killer called cancer. Surgery, radiation, chemotherapy, or a combination of these methods are used to treat cancer (or all). Anticancer

medications or qualities are any medication that is successful in treating malignant, or cancerous, disease. Alkylating agents, anti-metabolites, natural products, and hormones are a few of the main groups of anticancer medications. Environmental, nutritional, and lifestyle factors have been associated to higher cancer risks(60). In order to prevent and treat cancer, many scientists are looking for alternatives that are efficient, non-toxic, and economical. Blackberries/jamun have a lot of bioactive phytochemicals, including a variety of phytochemicals that have been shown to have anticancer properties recently, including

According to epidemiological evidence, consuming more dark-colored fruits like jamun can help reduce your chance of developing some malignancies by increasing your antioxidant intake. Jamun seeds contain some constituents with cytotoxic properties that can be used to create anticancer agents, particularly for lung cancer therapy, and to greatly benefit cancer patients. However, more research is needed to isolate the active components from these seeds(61). Jamun has anti-neoplastic, radio-protective, and chemopreventive properties that are all beneficial in the treatment and prevention of cancer. Thus, it can be concluded that jamun seeds have a number of characteristics that are anti-cancer, and additional research can be published on the health advantages of jamun seed.

## II. CONCLUSION-

For the treatment of several illnesses, including diabetes and its complications, jambolan is a common choice among traditional healers. The majority of the plant's traits are conferred by a variety of significant chemicals. A thorough investigation of the pharmacological potential of the plant's other components is necessary because the majority of pharmacological studies on diabetes have used seeds as their primary drug delivery system. The pharmacological effects of the phytochemical components of jambolan have also received little attention in the literature. Based on these data, the authors propose that additional phytochemical and clinical studies on this traditional medicinal plant be conducted in order to find safer medications. This review underlines the importance of jambolan in various treatments. (2)

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