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Jamun: An underutilized fruit loaded with nutraceuticals: A review

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Abstract

Jamun (*Syzygium cumini*) commonly known as Indian blackberry is an important fruit of Indian sub-continent and belongs to Myrtaceae family. Jamun has been proved to be a boon to human kind since time immemorial. Every part of the Jamun tree has high medicinal value, right from its fruit to its seed and bark to the leaves. It is an important fruit crop of Indian subcontinent, under-exploited and widely grown successfully due to its wider adaptability and nutraceutical properties. Fruits contain various types of antioxidants, flavonoids, phenolics, carotenoids and vitamins, which are all beneficial to human health. Jamun has also anti-diabetic, anticancer, antiviral, antibacterial and anti-hyper lipidemic properties. Fruits of Indian black berry are effectively in blood purifying. Seeds are effectively in anti-diabetic and leaves are effectively in strengthening the teeth. Jamun fruit is rich in antioxidants which can boost immune system, aid in digestion, relieve stomach pain, reduce flatulence and prevent infections. Jamun has astringent properties and keeps skin healthy. They are also used in nutrition, herbal medicine and cosmetics. The present review has been made to access several bioactive compounds and health benefits of Jamun.

Keywords: Jamun, phyto-chemical, nutraceuticals and medicinal

Introduction

There has been an increasing demand for health promoting foods by the consumers all over the world. This has led to the new term between nutrients and pharmaceuticals, called 'Nutraceuticals'. Nutraceuticals are diet supplements that deliver a concentrated form of a bioactive component from a food and used with the purpose of enhancing health in dosages that sometimes exceeds that of the normal. The medicinal properties of several herbal plants have been documented in ancient Indian literature and the preparations have been found to be effective in the treatment of diseases (Zeisel, 1995) [32].

Syzygium cumini Linn is an evergreen tropical plant. It belongs to the family Myrtaceae and native of India. Plants are highly valuable and are used by the people since thousands of years as a medicine to cure many diseases. It is popularly known as the Indian black berry. The plants are widely distributed throughout tropic and sub-tropic regions of India. Jamun is harvested prior to monsoon season and its harvesting time is short and limits for 30 – 40 days. It is an important fruit crop, under-exploited and widely grown successfully due to its wider adaptability and nutraceutical properties. It is an emerging fruit crop of the 21st century that plays an important role in medicinal properties as well as different plant parts possessed varied uses to mankind. It is a seasonal fruit and is highly nutritious; seeds have a great significance in treatment like Unani and Ayurvedic medicines. The fruit is rich in proteins, sugars and carbohydrates. The pericarp of the fruit appears blackish or dark purplish in colour and has a distinct sweet and sour taste. It is called the powerhouse of various nutritional components which acts as an immunity booster. The ripened fruits are eaten as fresh and also processing into health drinks, squashes, jam, wine and pickles. The seeds have a good source of secondary metabolites and its powder is highly used for curing the diabetes. The fruit of Jamun are very rich in antioxidant and also a good general tonic. Traditionally the plant is a good blood purifier and if the day is hot the fruit has a cooling effect. The Jamun leaf paste is used to subside the burning sensation of the body. Jamun have successfully been introduced into various other tropical countries like California, West Indies, Algeria and Israel. It is also grown in various countries like Thailand, Phillipines, Sri Lanka, Malaysia and Madagascar. The Jamun can easily be grown in marshy areas. The deep loamy and well drained soils are needed for high yield potential and plant growth. Leaves are opposite, simple, elliptic, pinnately veined with the lateral veins close together. At the time of flowering, the plant requires dry weather for better development. The February month is the peak period for panicle emergence while flowering and fruit set is observed in the month of March-April.

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Same findings were reported by Singh *et al.* (2012) [3] Thippeswamy, (2001) [5] and Singh *et al.* (2006) [4] Hosamani *et al.* (2008) [1] and Jindal *et al.* (2009) [2].

The present review presents specific information on botany, phytochemical constituents, traditional uses and pharmacological actions.

Botanical description of the Jamun

Jamun is a large and evergreen tree attaining a height up to 25-30 meter tall in India and Oceania or up to 12-15 m in Florida, USA, with a broad crown up to 11 m in diameter and a trunk diameter of 0.6-0.9 m though it usually has a multi-stemmed from branching close to the ground. The tree bark is light greyish and silver in colour and is very much resistant to water stagnation. Leaves are simple, opposite, entire, elliptic to broadly oblong. Leaves have a turpentine smell and 10-25 cm long, 3.0-10 cm wide pinkish when young, becoming leathery, glossy, dark-green above, lighter beneath, with a conspicuous, yellowish midrib when mature. Inflorescence of Jamun is borne in the axils of the leaves on the branchlets. Flowers are tiny, fragrant and appear in clusters of 2.5-10 cm long, hermaphrodite and light yellowish-white in colour and borne without any stalks. Stamens are as long as calyx and the leaves have a pleasant aroma. Fruits are oval to elliptical in shape, appear in clusters of just a few or 10-40 with round or oblong in shape and the colour varies from dark purple to black in colour. The skin is thin, smooth, glossy and adherent. The pulp is purple or white, very juicy and normally encloses a single, oblong, green or brown seed up to 4 cm long and some are seedless. The fruit is usually astringent, sometimes unpalatably and the flavour varies from acid to fairly sweet (Mortan, 1987) [17].

Phyto-chemical constituents in different parts of Jamun tree

Many researchers have already confirmed about the presence of various phyto-chemicals and bioactive compounds present in Jamun and all other parts of the tree. All the parts of Jamun trees including stems, flowers, seeds, fruits have some beneficial medicinal properties and it has already been described in various ancient medicinal recipes, which is considered as the backbone of Indian pharmaceutical industry. Even in Hindu religious epic Ramayana, the Jamun has got its importance because it is believed that Lord Rama survived for 14 years of his exilement by eating Jamun. Hence it is also considered as "Food of God".

Bark: Stem bark contains about 8-19% of tannin and it is very much useful for leather and preserving fishing net industry. The bark can treat for asthma, diarrhea, sore throat, diabetes, ulcers and blood impurities. The bark can also use for controlling blood pressure. The decoction of stem bark is taken orally three times a day for 4-5 weeks to treat for diabetes and also for repeated abortions. Apart from these, the barks can be used for making various furnitures.

Leaf: Leaf of this plant is used as astringents and exists anti-inflammatory property. The fresh leaves make a paste and apply on the affected areas on the skin and also helps in the

healing of wounds faster. It is also used in the treatment of vomiting, hemorrhoids, asthma, bronchitis, mouth wash, mouth ulcerations, dysentery and anti-venom. The juice of Jamun leaf is orally given as antidote to treat for opium poisoning and centipede bite. Fresh leaf paste are mixed with milk and taken orally to treat indigestion and diabetes. The tender leaf of Jamun is taken normally to treat Jaundice and can be used for strengthening gums and also for controlling constipation.

Fruit: The fruits of Jamun are not only used for medicinal purposes but also used in various food products. Fruits contain various types of antioxidants, flavonoids, phenolics, carotenoids and vitamins, which are all beneficial to human health. It also contains mallic acid and a small quantity of oxalic acid in its acid constituent. Gallic acid and tannins present in the fruit account for its astringency. The fruit is oval and berry type, initially appears green and gradually turn to light violet-red or purplish-red and finally dark purple at full maturity. The presence of cyanidine and diglycoside imparts purple color to the fruit. The pulp constitutes 73% of the fruit, while the seeds make up only 27% by weight. The fruits can cure the sore throat, headache, diarrhea, urine retention, ringworm of the scalp, diabetic problems, liver problems and the diseases of spleen. The fruits of Jamun are good source of iron and also used against asthma and heart diseases. Jamun juice is often mixed with mango juice and it acts as a very good drink for quenching thirst in the diabetic patient. Water diluted juice is used as a gargle for soar throat and as a lotion for ringworm of the scalp (Katiyar *et al.*, 2016) [14]. Fruits are also a rich source of iron; thus, it ensures the supply of properly oxygenated blood throughout the body (Joshi *et al.*, 2001) [13].

Seed: The seed of Jamun contains a glucoside jamboline, a new phenolic substance is used in various healing systems like Ayurveda such as diabetes. The Jamun seeds have hypoglycemic properties which lowers blood glucose level (Chaudhary *et al.*, 2012) [6]. Taking the dried extract of seeds orally decreases the blood sugar levels. The paste of seed powder taken orally once a day for two months to treat diabetes. The Jamun seed powder is good for astringent, antipyretic, analgesic and anti-inflammatory. The juice of seed powder of Jamun is applied externally to treat sores and ulcers, opium poisoning and in centipede bite. The seed powder mixed with sugar is given orally 2-3 times daily to treat for the treatment of dysentery (Ramya *et al.*, 2012) [21].

Phyto-chemistry of Jamun

Jamun fruits and all other parts are rich in various phytochemical compounds (Table 1). Fruits are rich in anthocyanins, glucosides, iso-quercetin, kaemferol, myrcetin etc. whereas, seeds contain a considerable amount of phytochemicals such as jambosine, gallic acid, ellagic acid, quercetin, β -sitosterole etc. Flowers are rich in oleanolic acid. Astringency or sourness of fruit is due to gallic acid and tannins. Roots also contain several flavanoids and glycosides (Sahu *et al.*, 2020) [24].

Table 1: Different phyto-chemicals present in different parts of Jamun tree (Sahu, *et al.*, 2020) ^[24]

Plant part	Phyto-chemical compounds	References
Bark	Ellagic acid, Gallic acid, Gallotannin, Ellagi tannin, Myricetin, β -sitosterole, Betuleninic acid	Bhargava <i>et al.</i> (1974) ^[3] ; Nair <i>et al.</i> (1974) ^[19] ; Yogeswari <i>et al.</i> (2005) ^[31]
Leaves	Bornyl acetate, Triantanol, n-Dotricontanol, Quercetin, Maslinic acid, Betulinic acid, Myricetin, n-nonacosane, n-dotricontanol	Craveiro <i>et al.</i> (1983) ^[9]
Flowers	Oleanolic acid, Ellagic acid, Iso-quercetin, Kamferol, Myricetin, Dihydro-myricetin, Quercetin, Arabinoside	Nair <i>et al.</i> (1974) ^[19] ; Sagarwat <i>et al.</i> (2006) ^[23]
Fruits	Raffinose, Citric acid, Fructose, Glucosides, Gallic acid, Malic acid, Anthocyanin, tannins, Delphinidin, Petunidin, Malvidin	Srivastava <i>et al.</i> (1953) ^[29] ; Lewis <i>et al.</i> (1956) ^[15]
Seeds	Fats, Jambosine, Gallic acid, ellagic acid, Quercetin, β -sitosterole other elements like Chromium, Vanadium, Potassium, Sodium, Zinc, tannins	Nadkarni <i>et al.</i> (1954) ^[18] ; Chopra <i>et al.</i> (1956) ^[8] ; Bhatia <i>et al.</i> (1975) ^[4]
Roots	Flavonoids, Glycosides and isorhamnetin 3-O-rutinoside	Vaishnavi <i>et al.</i> (2012) ^[30]

Bioactive compounds present in Jamun

Bioactive compounds are such chemical substances which are found in a very minute amount in various fruits (Table 2).

Several bioactive compounds present in Jamun are terpenes, flavanoids, lipids, alkanes, phenols etc.

Table 2: Bioactive compounds present in Jamun (Sahu *et al.*, 2020) ^[24]

Bioactive compound	Compounds present	Uses	Reference
Terpenes	1,8-cineol, Mysterol, Terpinolene, Linalool oxide, β -terpenene, β -pinema, Citronellol, Eugenol	For pleasant flavour, Food additives and Pharmaceutical	Cho <i>et al.</i> (2017) ^[7]
Flavanoids	Iso-quercetin, kampferol, Malvidin, Myricetin, Petunidin, Quercetin, Anthocyanin, Cyanidin diglycoside	Antioxidant and Colouring agent	Shashank <i>et al.</i> (2013) ^[27]
Lipids	Lauric acid, Linoleic acid, N-nanocosane, Stearic acid, N-hentriacontane, myristic acid, Lauric acid	Nematicide, Antioxidant and Anti-acne	
Alkanes	Malic acid, Citric acid	Antioxidant and Antiseptic	
Phenols	Ferulic acid, Caffeic acid	Allelopathic and Antibacterial	

Pharmacological activities of Jamun**Antioxidant**

Jamun are rich sources of several minerals like potassium, sodium, magnesium, total dietary fibres and calcium. It was found that fruits had low to medium phenolic content and the kernel had low dietary fibre than that of pulp. Jamun leaves contain phenolic compounds such as ferulic acid and catechin and these two are responsible for antioxidant property (Ruan *et al.*, 2008) ^[22].

Antimicrobial

Jamun leaves have significant antimicrobial activity against both gram-positive and gram-negative bacteria. The advantage is that these trees are locally available and can be a cheap and sustainable way to irradiate any microbial contamination, particularly in developing countries (Elfadil *et al.*, 2015) ^[10].

Anti-diabetic

Diabetes is becoming the third “killer” of the health of mankind along with cancer, cardiovascular and cerebrovascular diseases because of its high prevalence, morbidity and mortality (Li *et al.*, 2003) ^[16]. Gajera *et al.* (2017) ^[11] studied about the association of anti-diabetic and antioxidant substances with phenolic constituents from indigenous Jamun varieties. It was found that the fruit size was negatively correlated with phenols, anti-diabetic and antioxidant activities. It was also confirmed that seeds had more antioxidant and anti-diabetic property due to their kernel fraction. Shankar *et al.* (2007) ^[26] did an experiment to study the activity of two novel androgens (JB1 and JB2) derivatives isolated from ethanolic extracts of Jamun seeds and anti-diabetic effect of both was evaluated by using alloxan as

diabetogenic agent. It was found that JB1 was more effective as compared to JB2.

Blood purifier

Jamun is rich in iron, hence it can truly act as a blood purifier, so that there will be enough production of haemoglobin. Hence it acts as a protective food for menstruating women (Katiyar *et al.*, 2016) ^[14].

Anti-diarrhoeal property

Diarrhoea is often proved to be a fatal disease in both tropics and subtropics, causing around 5 million deaths annually throughout the world. Shamkuwar *et al.* (2012) ^[25] found that aqueous Jamun seed extracts caused a significant and dose-dependent anti-diarrhoeal and anti-mortality effect.

Anticancer property

Now a day's cancer is proved to be a killer disease. A majority portion of cancer-treating drugs are derived from natural resources. Very often, women are suffered from breast cancer. Aquil *et al.* (2016) ^[11] conducted an experiment to study the potential of Jamun against 17β -estrogen-mediated breast cancer and the study of m-RNA in inhibition of disease. Female rats were artificially fed with the diet enriched with Jamun supplement. After two weeks the rats received 17β -estradiol and were palpated weekly for mammary tumors. After 26 weeks, it was found that the Jamun enriched diet significantly delayed the first tumor appearance by 21 days. It also reduced the tumor incidence and tumor multiplication as compared to control.

Anti-inflammatory property

The anti-inflammatory activity of ethyl acetate and methanol

extracts of Jamun leaf extract had excellent anti-inflammatory property (Jain *et al.*, 2008) [12]. Apart from these, it was found that the Jamun seeds had exudative, proliferative as well as antipyretic effect.

Antibacterial property

Phyto-chemical extracts derived from seeds had several antioxidant properties which can be further utilized for treating various fatal diseases and it was also found that methanol derived extracts had more antibacterial property. Pareek *et al.* (2015) [20] found that stem and leaf extracts had excellent antibacterial property against all bacteria and the maximum antibacterial effect was against *Rouletella plantikol*, *Bacillus subtilis*, *Salmonella sp.*, *Pseudomonas aeruginosa*, *E. Coli*.

Antiviral and Antifungal property

It was found that the hot and cold crude extracts of Jamun leaf and bark had antiviral property against avian influenza H5N1 virus. Singh *et al.* (1971) [28] studied the effect of water extract of Jamun bark on potato x virus and it was found that the extract had antiviral property. It was also confirmed the antifungal property of Jamun bark and leaves against *Rhizoctonia solani*. Bark extracts were more powerful as compared to the leaf extracts for antifungal property.

Free radical scavenging and anti-lipid peroxidative property

Benherlal *et al.* (2007) [2] carried out an experiment to study the *in-vitro* antioxidant, lipid peroxidative inhibition activity and chemical composition of Jamun fruits and the medicinal property of fruit pulp, kernal and seed coat. It was seen that seed and pulp extracts had lower anti-lipid peroxidative property than the kernel.

Antiulcer property

Ulcer is a detrimental disease and it was found that the seeds of Jamun had ulcer curing capability in diabetic rats (Chaturvedi *et al.*, 2007) [5].

Conclusion

In spite of its high nutritional and medicinal values the commercial cultivation is lacking which needs to be popularized for commercial acceptance and orchard establishment in arid and semiarid regions of the country. Its fruit has a high potential source of nutritional and medicinal values. The value-added products of the crop need to catch national and international focus so that its nutritional and medicinal characteristics can be utilized in an ideal manner. In India some of the major fruit trees like mango, banana, citrus, guava etc. are cultivated on a large scale still Jamun is cultivated on minimal scale which still collects from forest areas. Despite many phytochemicals and pharmaceutical property in Jamun still, its cultivation is very limited and thus it needs more exploration. Jamun is a rich source of several important phytochemicals and other biochemical compounds. Still, remained as an under-exploitable crop or underutilized crop. It is an emerging fruit crop of 21st century that could play an important role in high medicinal value as well as different plant parts possessed varied uses to mankind. Hence, people should be aware of the health benefits that Jamun poses so that we can go towards a healthy society.



Fig 1: Jamun Seeds



Fig 2: Jamun fruits



Fig 3: Jamun flowering



Fig 4: Jamun bark



Fig 5: Jamun leaves

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