

# Jamun (*Syzygiumcumini* L.) Seeds: A Review on Phytochemistry, Pharmacology, Nutritional Profile and traditional uses

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## ABSTRACT

Jamun (*Syzygiumcumini* L.) seeds are highly perishable with a very short shelf life, hence, jamun fruit is either consumed fresh as soon as it is harvested or converted to value-added products such as jam, wine, juice, and jellies. An enormous quantity of seeds is produced as the main waste during the preparation of jamun fruit. Jamun seeds are a significant component in the food business since they are a rich source of macronutrients such as carbs, proteins, lipids, minerals, and vitamins. Byproducts of the food processing industry that are underutilised yet are nutrient-dense have been given newfound value, opening up new opportunities for using them in functional food or therapeutic food compositions. The goal of the current analysis is to explain the phytochemicals present in the various plant parts of jamun plants. Along with its advantageous nutritional profile, the review sheds light on the safety concerns related to consuming jamun seeds as well as the recommended daily intake. Studies on safety and toxicity have encouraged academics and entrepreneurs to look at potential uses in the food industry. Jamun seeds, which have a variety of nutritional advantages, can be an essential functional ingredient. However, additional investigation is required to determine the best ways to use jamun seeds in food products so that they can maximise their nutritional value without affecting their sensory appeal.

**KEYWORDS:** Jamun, astringent, evergreen leaves, phytochemicals, fruit pulp of Jamun, diabetes, potential, sensory appeal.

## INTRODUCTION

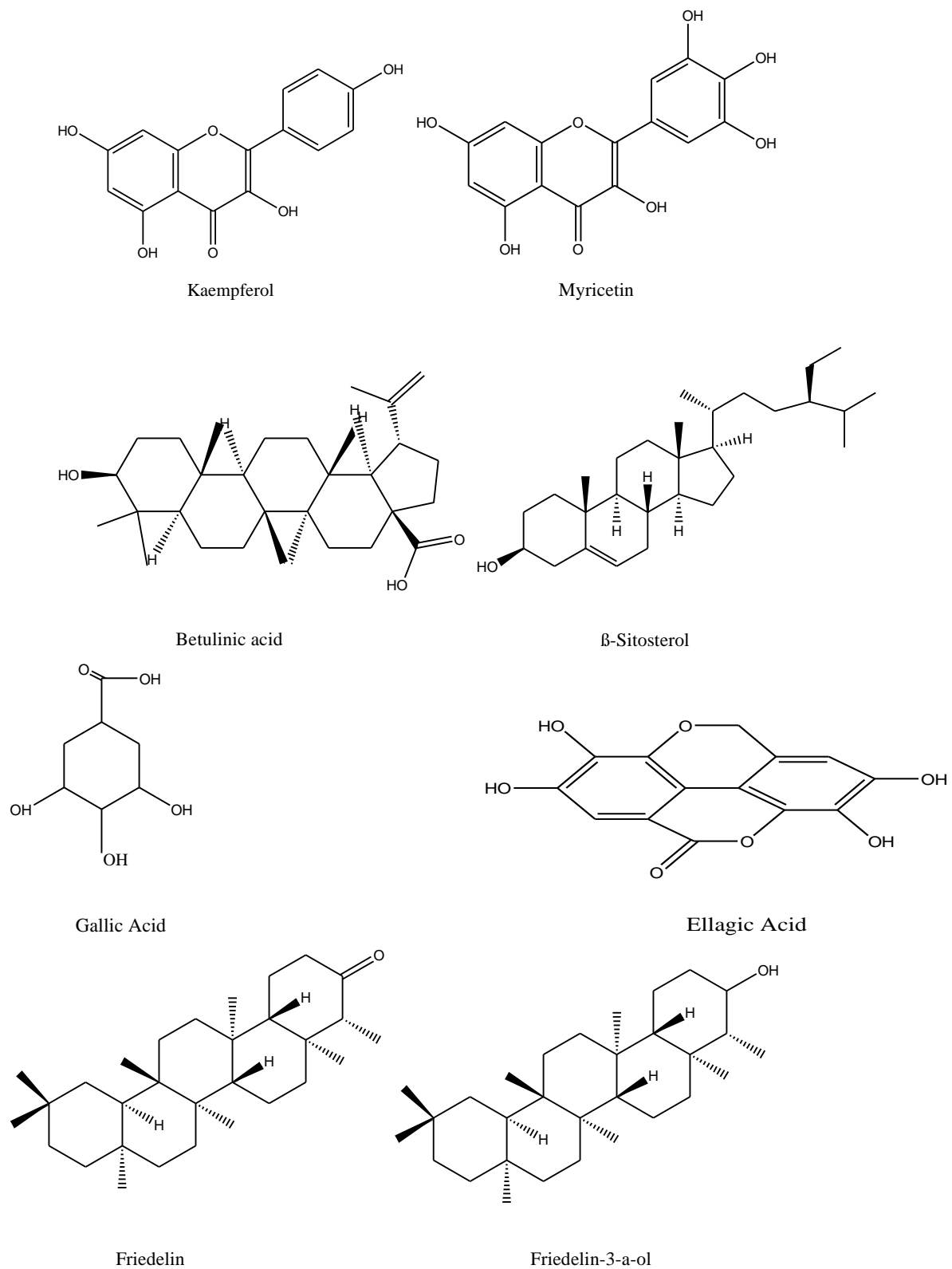
The black plum, also known as jamun or *Syzygiumcumini* Linn, is a member of the Myrtaceae family and is used widely in several traditional medical practises in India, Madagascar, Thailand, the Philippines, and other nations. Even though research has showed that *Syzygiumcumini* seeds have more fibre (4.19%) than pulp (1.76%). The seeds are often discarded as waste following pulp consumption. *Syzygiumcumini* seeds are said to contain alkaloids including jambosine and the glycoside jambolin, also known as antimellin<sup>[1]</sup>. The presence of phenolic chemicals in *Syzygiumcumini* seeds has been credited in part for their medicinal value.

When the leaves are mature, they are turpentine-colored, dark green with a yellow midrib, and the plant's wood is waterproof. Livestock is fed on this plant's leaves<sup>[2]</sup>. The plant as a whole has good nutritional qualities. From February through May, this plant begins to bloom. Its little, fragrant flowers have a diameter of around six millimetres. The fruits mature between April and July<sup>[3]</sup>. Oblong and a dark grey tint, *Syzygiumcumini* fruits have a blend of sweet, sour, and harsh flavours<sup>[4]</sup>.

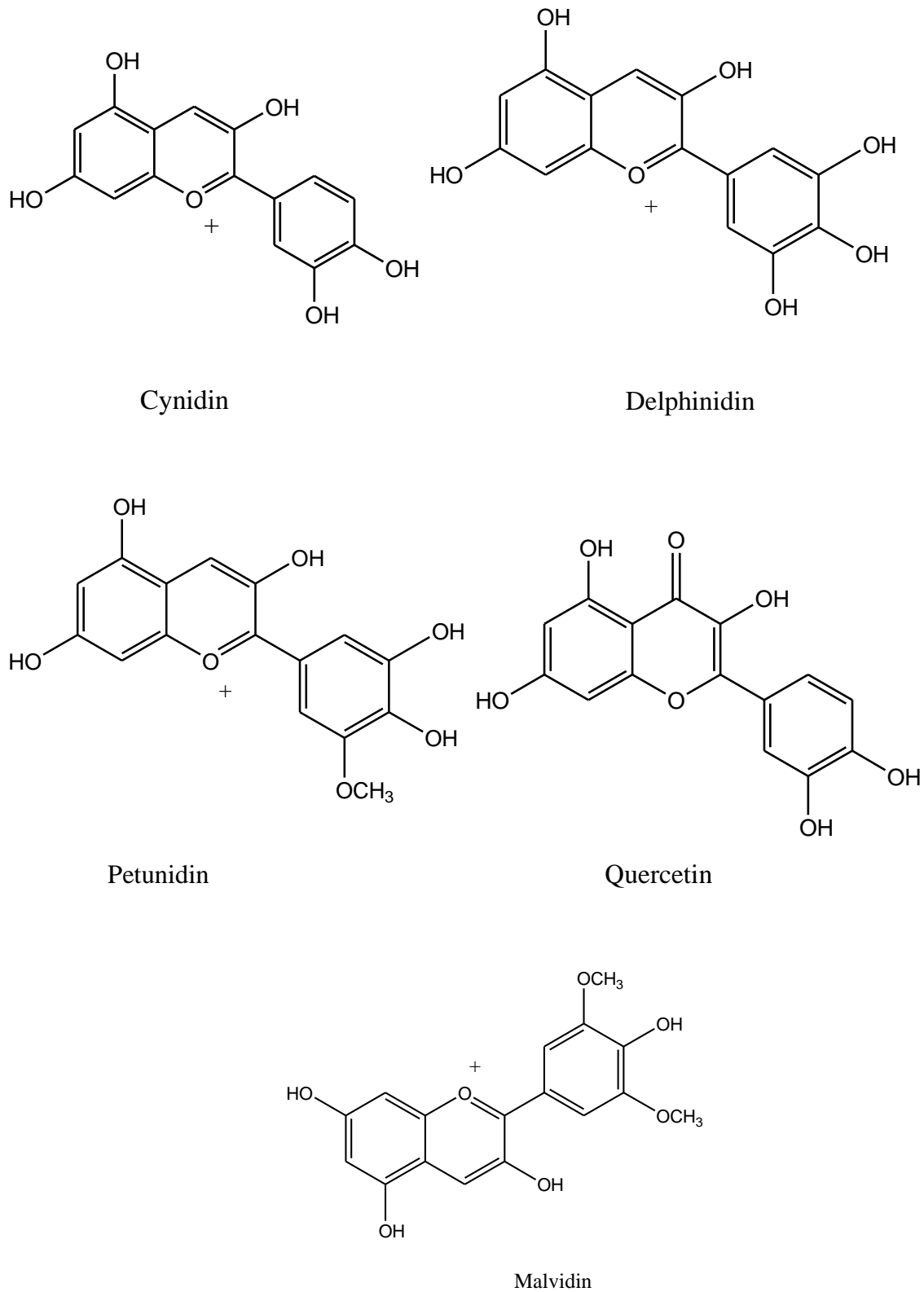
## BOTANICAL DESCRIPTION

*Syzygiumcumini* is a fast-growing tropical and sub-tropical tree preferring moist, riverine habitats. It may reach up to 30 m tall in India. The bark is rough, cracked, flaking and discolored on the lower part of the trunk, becoming smooth and light-grey. Evergreen leaves have a turpentine smell with oval or elliptic shape and tapering to a point at the apex. The leaves are pink in color at the younger stage and become leathery and glossy. On the top, it is dark-green but lighter beneath. When mature, a conspicuous, yellowish midrib appears. Flowers are fragrant with a funnel-shaped calyx and 4-5 united petals. Fruit appears in clusters of just a few or 10-40, with 1.25-5 cm long and round or oblong, often curved in shape. Fruit then changes colour from green to bright magenta, dark magenta, or even black. Skin has a thin, smooth, and shiny texture. *Syzygiumcumini* has purple or a white, extremely juicy pulp. A 4 cm long encloses the pulp.

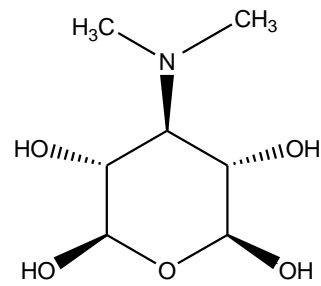
Single, oblong, green or brown seed. In some fruits, 2-5 seeds are present within a leathery coat, and some are seedless. The fruit is usually astringent, sometimes unpalatable, and the flavor varies from acid to moderately sweet. *Syzygiumcumini* propagates easily from fresh seed. The seed cotyledons consist of single layered epidermis. Mesophyll is composed of isodiametric thin-walled, parenchymatous cells fully packed with simple starch grains, oval, rounded measuring 7-28  $\mu$  in diameter a few schizogenous cavities are also found. *Syzygiumcumini* begins bearing fruit when 8-10 years old. *Syzygiumcumini* is a tropical species preferring mean annual temperatures around 25-27°C. *Syzygiumcumini* grows best in wet regions with annual rainfall, more than 1000 mm and up to 4000 mm. *Syzygiumcumini* is thus native to India, Sri Lanka, and Myanmar but also reported to be grown in Australia, Philippines, Pemba Kenya, Florida West Indies, East and West Africa, etc.



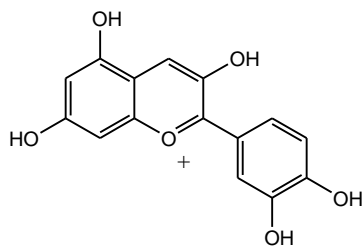
**Fig 1.1: Structure of Phytochemicals present in “Stem bark of Jamun” plant**



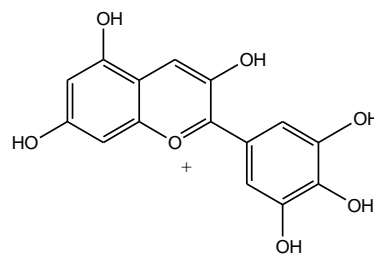
**Fig 1.2: Structure of Phytochemicals present in “Fruit pulp” of Jamun plant**



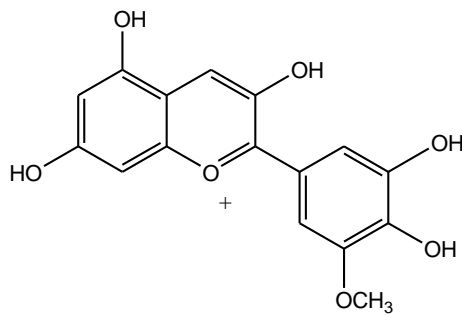
Mycaminose



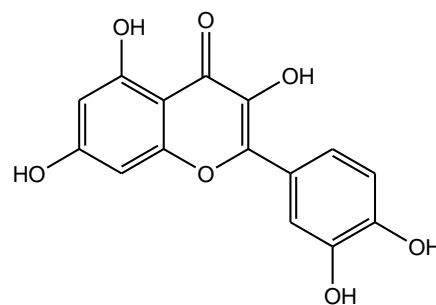
Cynidin



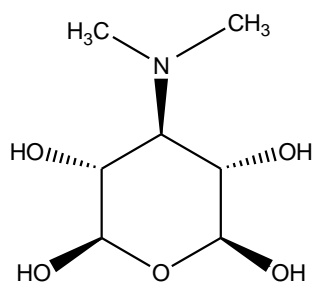
Delphinidin



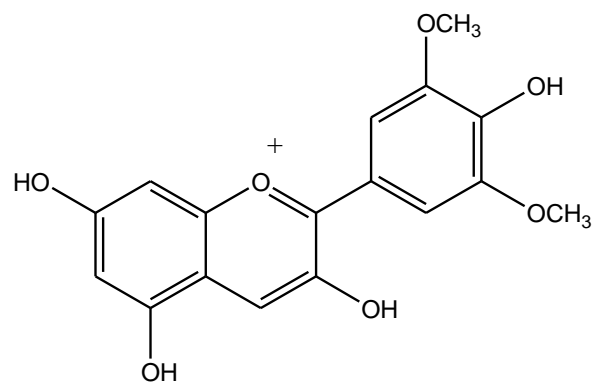
Petunidin



Quercetin



Mycaminose



Malvidin

**Fig 1.3: Structure of Phytochemicals present in “Leaves” of Jamun plant**

**TAXONOMY**

Common names: Duhat, jambolan, plum, jamelouguier, kavika, mesegerak, black plum; Indian blackberry; jambolan; jambolan; jamun; Java plum; Malabar plum; Portuguese plum

**Botanical names:**

*Syzygiumcumini* (L.) skeels, *Calyptanthes jambolana* Willd, *Eugenia cumini* (L.) Druce, *Eugenia jambolana* Lam., *Myrtus cumini* L., *Syzygium jambolana* Lam., *Syzygiumjambolanum* DC.

**Kingdom:** Plantae

**Subkingdom:** Viridiplantae - Vascular plants

**Infrakingdom:** Streptophyta

**Superdivision:** Embryophyta

**Division:** Tracheophyta

**Subdivision:** Spermatophytina - Seed plants

**Class:** Magnoliopsida - Dicotyledons

**Superorder:** Rosanae

**Order:** Myrtales

**Family:** Myrtaceae - Myrtle

**Family Genus:** *Syzygium*

**Species:** *Syzygiumcumini* (L.) Skeels

*Syzygiumcumini* seeds are reported to have compounds belonging to the class of flavonoids, alkaloid, tannin, lipid, coumarine, glucoside, alkane, benzenoids, etc. A compiled data on the literature review of all the compounds present in *Syzygiumcumini* seeds is depicted in **Table 1.1**.

**Table 1.1: Chemical constituents reported in *Syzygiumcumini*seed**

Compound	Class	Reference
Jamboline	Glucoside	Ayyanar et al., 2012
Rutin	Flavonoid	Arun et al., 2011
Mycaminose		Srivastava et al., 2013
Medioresinol-4"-O-β- glucosid	Lignan glycoside	Martin et al., 1998
Pinoresinol-O-β-glucoside	Lignan glycoside	Martin et al., 1998
Jambosine	Alkaloid Ayyanar et al., 2012	Ayyanar et al., 2012
3,6-hexahydroxy Diphenoylglucose	Tannin	Bhatia and Bajaj, 1975
β-sitosterol	Triterpenoid	Sagrawat et al., 2006
Quercetin	Flavonoid	Sagrawat et al., 2006
4-(2-2-dimethyl-6-6-methylenecyclohexyl)butanol	sesquiterpenoids	Kumar et al., 2009
Corilagin	Tannin	Bhatia and Bajaj, 1975

**Table 1.2: Phytochemicals present in the jamun plant**

Sr. No	Plant part	Chemicals present
1.	Seeds	Jambosine, gallic acid, ellagic acid, corilagin, 3,6-hexahydroxy diphenoylglucose, 1-galloylglucose, 3-galloylglucose, quercetin, $\beta$ -sitosterol, 4,6 hexahydroxydiphenoylglucose, .
2.	Stem bark	Friedelin, friedelan-3- $\alpha$ -ol, betulinic acid, $\beta$ -sitosterol, kaempferol, $\beta$ -sitosterol-Dglucoside, gallic acid, ellagic acid, gallotannin and ellagitannin and myricetine .
3.	Flowers	Oleanolic acid, ellagic acids, isoquercetin, quercetin, kampferol and myricetin.
4.	Fruit pulp	Anthocyanins, delphinidin, petunidin, malvidin-diglucosides.
5.	Leaves	$\beta$ -sitosterol, betulinic acid, mycaminose, crategolic (maslinic) acid, n-hepatcosane, n-nonacosane, n-hentriacontane, noctacosanol, n-triacontanol, n-dotricontanol, quercetin, myricetin, myricitrin and the flavonol glycosides myricetin 3-O-(4"-acetyl)- $\alpha$ Lrhamnopyranosides .
6.	Essential oils	$\alpha$ -terpeneol, myrtenol, eucarvone, muurolol, $\alpha$ -myrtenal, 1, 8-cineole, geranyl acetone, $\alpha$ -cadinol and pinocarvone.

### PHYTOCHEMICAL AND MEDICINAL STUDIES

*Syzygiumcumini* phytochemical helps to bring human beings from disease to health status (Vital Force) without any side effects. In this plant leaves have myricitrin, myricetin, noctacosanol, mycaminose and maslinicacid<sup>[5,6]</sup>. *S. cumini* seeds are gallic acid, ellagic acid, Jambosine and quercetin etc., plants flowers have myricetin, kampferol, ellagic acides and oleanolic acid<sup>[5,7]</sup>. *Syzygium* stem are gallotannin, myricetine, ellagitannin, betulinic acid, friedelin, gallic acid and kaempferol. This plant fruits contain petunidin, anthocyanins and delphinidin<sup>[5,6,8]</sup>. It is widely used throughout India and in Homoeopathy medicine for the treatment of Type 2 Diabetes Mellitus and DiabetesInspidus.

*Syzygiumcumini* fruits contain glucoside, ellagic acid. This acid cause starch which convert in to glucose in case of Hyperglycemia conditions<sup>9</sup>. The whole plant can be used in different ailments like inflammatory conditions, colic, amoebic and bacillary dysentery, fistula, cough with expectoration, blisters in decades worm infections and diabetes<sup>10</sup>. These plants are also used in cancer, abdominal pain, gastrooesophageal diseases and piles<sup>[11]</sup>.

In homoeopathic and ethnobotanical literature the following medicinal actions of *SyzygiumJambolanum* plant have been reported that Diabetes and inspidius patients have much thirst with profuse flow of wine in every two hours. Skin is prickly heat in upper part of the body: small red pimples, which itched violently, old ulcers of the skin, diabetic ulceration; old ulcers of skin, probably of a diabetic foundation<sup>[12]</sup>.

Recent Phytochemical Studies showed that the *Syzygiumcumini* bark contains carbohydrates and tannins etc., accounting for its long-term use as an astringent to combat ailments like dysentery<sup>[13]</sup>. This plants seeds, bark and fruits shown that anti-inflammatory action, antipyretic action in rats and antioxidant action in known case of diabetic rats<sup>[14]</sup>.

Homoeopathic *Syzygiumcumini* mother tincture useful for liver, increase in blood (anemia conditions), gingivitis and also for worm infections in adult and old persons. The whole plants as an mother tincture indicated in uncontrolled Type 2 Diabetes mellitus patients, such as hypoglycemia as well as hyperglycemia and prevent complications of diabetes i.e. Diabetes Neuropathy, Diabetes retinopathy and diabetes nephropathy<sup>[15]</sup>. *Syzygiumcumini* whole plant (fruits, leaves, seeds, bark) having large usages in Global Homoeopathy system especially in gastric ulcers. Because *S. Cumini* have rich in gastroprotective activity (due to its effects on both defensive and offensive factors). Indian medical as well as International medical journals conclusion that *Syzygiumcumini* can be beneficial in human with diabetes.

## PHARMACOLOGICAL STUDIES

**Anti diabetic Activity:** According to Karnic et al the *Syzygiumcumini* (ethanolic) have decrease blood sugar level by 20 percentages after 1 hour in excessive glucose in rabbits<sup>[16]</sup>. According to Bansal et al., reported that hypoglycemia controlled by after oral application of *S. Cumini* seed (cathepsin increase activity)<sup>[14]</sup>. Bose and Achrekar proved the clinical effectiveness of the *Syzygiumcumini* seeds in untreated control diabetic animals<sup>[18,19]</sup>. Many research studies showed that this plant fruit increase stimulation of insulin secretion in case of hypoglycemic condition.

The *Syzygiumcumini* seeds action of mechanism due to the potentiation of insulin effect of plasma by elevation pancreatic secretion of insulin from beta cells of islets of langerhans and its release from the bound from mechanism of mycaminosesimilar to the glibenclamide.

**Anti Allergic Activity:** Brito studies showed that this plant seeds shows antiallergic effect is due to the inhibition of mast cell degranulation and of histamine and serotonin effects whereas the inhibition of eosinophil accumulation in the allergic pleurisy model<sup>[20]</sup>.

**Anti Inflammatory Activity:** Muruganandan study shows that *Syzygium* seeds have a potent anti inflammatory activity without any side effect to gastric mucosa and other systems also. He also noticed that more anti inflammatory activities are in *Syzygiumcumini* stem and seeds<sup>[21]</sup>.

**Anti Pyretic Activity:** Sharma et al. evaluated chloroform extracts of dried seeds showed antipyretic activity and Dr. Mahapatra studied methanol extracts of *Syzygium* seeds administered intraperitoneally to rats at dose of fifty mille grams per kg were active versus yeast induced pyrexia<sup>[22]</sup>.

**Anti Diarrhoeal Activity:** Mukherjee explained that antidiarrhoeal activity in *Syzygium* against different experimental models of diarrhea in rats. It produced significant inhibition of diarrhea and significant decreased gastrointestinal motility in rats (charcoal meal tests)<sup>[23]</sup>.

## FUNCTIONAL FOOD PROPERTIES

A physicochemical, vitamin, and mineral examination of *Syzygiumcumini* has shown that it contains adequate amounts of protein, fat, ascorbic acid, and minerals (iron, calcium, and potassium). Food scientists can thus employ *Syzygiumcumini* to create functional foods. Due to the vital functions that carbohydrates, proteins, fats, and dietary fibre play in the body, their inclusion in JS powder has enabled a number of goods to progress in terms of technology. Products' internal features, including calorific value, prebiotic score, glycemic index, and antidiabetic potential, as well as their shelf life, may be used to characterise their technical properties<sup>[24,25]</sup>.



*Syzygiumcumini* can be used to bind, clarify, flocculate, thicken, stabilise, whip, coat, prevent staling, and encapsulate food goods. They are mostly made of carbohydrates. The majority of the digestible carbohydrates in *Syzygiumcumini*, which range in quantity from 23 g/100 g to 60 g/100 g, are made up of starch. These carbs give the body the fuel it needs to sustain a variety of metabolic processes. Additionally, it was found that JSs were a great source of dietary fibre, which along with lignin made up the non-digestible carbohydrates that are so important for maintaining good health. Proteins make up up to 8% of *Syzygiumcumini* DM and may provide food its flavour, foaming, swelling, browning, coagulation, denaturation, water and oil retention capabilities, and water absorption<sup>[26,27]</sup>.

Despite the small total lipid content (below 1.5 g/100 g), the fatty acid composition of the lipids in jamun seed is healthy and balanced. Three types of fatty acids may be distinguished: saturated, monounsaturated, and polyunsaturated. 50% of all fatty acids are saturated fatty acids (SFA). The plasticizing, emulsifying, aerating, shortening, and oxidative stability that these fats offer may be advantageous for certain food items. The refractive index, specific gravity, saponification value, and other metrics can be used to represent the functioning of an oil or fat<sup>[28]</sup>.

Foods that naturally have less protein, fat, ash, and fibre than *Syzygiumcumini* do so because adding *Syzygiumcumini* powder raises their levels of these constituents, which changes the end product's quality. High prebiotic activity (2.16 0.05) was found in a functional confection containing JS, on par with inulin. Additionally, the dish now has a low glycemic index with a glycemic index of around 50. The functional confection with high  $\alpha$ -amylase inhibitory activity (IC<sub>50</sub> = 83.89 mg) and a high glucose dialysis retardation index also showed promise as an anti-diabetic agent in in vitro experiments<sup>[29]</sup>.

Profile analysis of *Syzygiumcumini* oil revealed that it has a specific gravity of 0.9432, an acid value of 1.711 mg NaOH/g, a saponification value of 180 mg KOH/g, and an iodine value of 97.12 g I<sub>2</sub>/100 g, all of which classify it as a non-drying oil with a moderate capacity for washing and a high binding capacity. This oil is a prospective component for the beauty and pharmaceutical sectors due to its distinguishing qualities. High iodine readings and acid numbers, however, suggest oxidation susceptibility, which limits its use in food items<sup>[30]</sup>.

## MEDICINAL PROPERTIES

It is used to heal ulcers, biliousness, thirst, bronchitis, and asthma. It is also astringent to the intestines, digestive, and an anthelmintic. It also works well to purify blood. The fruit is astringent to the intestines, acrid, sweet, cooling, and eliminates unpleasant odour from the mouth, as well as being stomachic, astringent, diuretic, and anti-diabetic. There is presently a sizable market for the fruit's usage in treating chronic diarrhoea and other intestinal disorders. The fruit has a very long history of use for numerous therapeutic uses. The seed is beneficial for diabetes, astringent to the intestines, and delicious. The teeth and gums are strengthened by the leaf ash. Vinegar made from ripe fruit juice has a pleasant stomachic and carminative effect.

In contrast, juice of tender leaves alone or in combination with carminatives like cardamom or cinnamon is given in goat's milk to treat diarrhoea in children.

Juice of tender leaves of this plant, leaves of mango, and myrobalan are mixed and administered along with goat's milk and honey to treat dysentery with bloody discharge. Since ancient times, traditional medicinal practitioners in Madagascar have used jambolan seeds as the main component of an efficient therapy to combat the slowly crippling effects of diabetes. The peasants of Tamil Nadu utilise the seed extract to cure colds, coughs, fevers, and skin issues such rashes and ulcers in the mouth, throat, intestines, and genitourinary system (caused by *Candida albicans*)<sup>[31]</sup>.

Different portions of the plant are used by different traditional healers in India to cure conditions like diabetes, mouth blisters, cancer, colic, diarrhoea, digestive disorders, dysentery, piles, acne, and stomachaches.

Numerous folk medicine claims on this plant's antidiabetic benefits have been mentioned in the literature during the past 40 years. Various components of *Syzygiumcumini* are used in unani medicine to treat ringworm of the head, strengthen teeth and gums, function as a liver tonic, and enrich blood.

Since it first became commercially accessible decades ago, the plant has been regarded as an antidiabetic herb. The antidiabetic action of several components of *Syzygiumcumini* in diabetic animals was first described in the early 1960s through the 1970s. The majority of these research have used a crude plant preparation without mentioning the chemical makeup of the plant, and the antidiabetic activity in animals is not well understood. On the recommendation of the doctors, many herbal preparations that included this plant and were commercially accessible and had potential antidiabetic efficacy are commonly taken by diabetic patients. There have also been reports of the *Syzygiumcumini* antioxidant, anti-inflammatory, neuropsychopharmacological, antibacterial, anti-HIV, antileishmanial and antifungal, nitric oxide scavenging, free radical scavenging, anorexigenic, gastroprotective and anti-ulcerogenic, and radioprotective activities in various parts of the body<sup>[32]</sup>.

## MEDICINAL USES

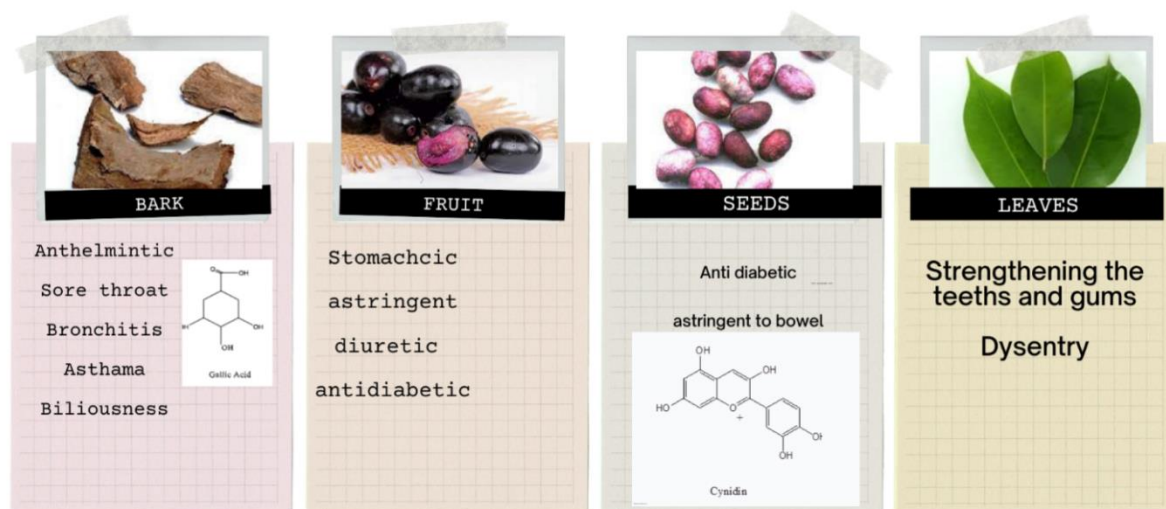


Fig1.4 : medicinal uses of *Syzygiumcumini*

## HEALTH-PROMOTING APPLICATIONS

The use of seed extract in various cuisines necessitates the stability of phytochemicals and versatility in application. In order to create marketable formulations for the food and pharmaceutical sectors, researchers have investigated encapsulating technologies including spray drying. The nutritional makeup of *Syzygiumcumini* is ideal for creating baked foods with a low glycemic index, excellent digestibility, and advantages for liver health. JS powder makes a suitable combination with whole wheat flour for beneficial cookies, biscuits, and cakes due to its low-to-medium protein concentration, high dietary fibre content, and calcium content. Due to its antibacterial and antioxidant qualities, powder enhances not only the operation of the goods but also their maintenance features. As a result of the significant retention of the seed extract's antioxidant capacity during processing and heat treatment, it has the potential to replace synthetic antioxidants in oils, beverages, processed meat and dairy foods and their products, cosmetic products, active packaging systems, and textiles<sup>[33,34]</sup>.

## CONCLUSION

The information collected above on *Syzygiumcumini* across the globe having similarity with available literature. *Syzygium* plant bark, seeds, leaves; fruits are used for the treatment of different diseases especially in Type 2 Diabetes Mellitus (Chronic) and Diabetes Insipidus. According to the review literature, the *Syzygiumcumini* medicinal plants are safer in admission for various diseases. These plants were used successfully for different diseases in different countries with safe results. This review describes the information about *Syzygium* which includes Homoeopathic description, botanical description, medical action and Phytochemical and pharmacological studies. *Syzygium* is one of the plants used in Homoeopathic system for the treatment of chronic Type 2 Diabetes Mellitus[15] and insipidus, urinary system, upper respiratory, worm's infections, lower intestinal tract, skin and diabetic ulcerations.

## References

- 1) Ayyanar M, Subash-Babu P. *Syzygiumcumini* (L.) Skeels: A review of its phytochemical constituents and traditional uses. *Asian Pacific Journal of Tropical Biomedicine*. 2012 Mar 1;2(3):240-246.
- 2) Janick Jules and Paull Robert E. (2008). *The Encyclopedia of Fruit & Nuts*. CABI International, United Kingdom, 1-160. ISBN: 978-0-85199-638-7.
- 3) Chen Jie and Craven Lyn A. (2017). *Syzygium*. in Wu, Zhengyi; Raven, Peter H. & Hong, Deyuan, *Flora of China* (online), eFloras.org, retrieved 2015-08-13.
- 4) Veeram, Anjali & Sindhu, G. & Girish, Chiruthanur. (2017). A review on pharmacology and phytochemistry of *syzygiumcumini*. *Indian Journal of Pharmaceutical and Biological Research*. 5. 10.30750/ijpbr.5.4.5.
- 5) Sagrawat H. Pharmacological Potential of *Eugenia Jambolana*: A Review. *Pharmaco-genesis Magazine*. 2006; 2(6), 96-105.

- 6) Veigas J., Narayan M., Neelwarne B. and Laxman P., Stability and Bio Efficacies of Anthocyanins from Fruit Peel of *Syzygiumcumini* Skeels. Food Chemistry. 2007; 105(2), 619-627.
- 7) Rastogi R. and Mehrotra B., Compendium of Indian Medicinal Plants. Central Drug Research Institute, Lucknow, 1990; 1, 174-178.
- 8) Li L., Adams L., Killian Caroline, Ahmed Aftab, Seeram Navindra P. and Chen S., Eugenia jambolana Lam. Berry Extract Inhibits Growth and Induces Apoptosis of Human Breast Cancer but Not Non-Tumorigenic Breast Cells. Journal of Agriculture and Food Chemistry, 2009; 57(3), 826-831. doi:10.1021/jf803407q
- 9) Giri J., Sathidevi T. and Dushyanth N., Effect of Jamun Seed Extract on Alloxan Induced Diabetes in Rats. Journal of the Diabetic Association of India, 1985; 25, 115-119.
- 10) Reynertson K.A., Basile M.J. and Kennelly E.J., Antioxi-dant Potential of Seven Mystaceous Fruits. Ethnobotany Research and Applications, 2005; 3, 25-36.
- 11) Jain S.K. (1991). Dictionary of Indian Folk Medicine and Eth-nobotany. Deep Publications Paschimvihar, New Delhi.
- 12) Boericke W. (1999). Pocket Homoeopathic Materia Medica Text Book. B.Jain Publications, New Delhi, 1073.
- 13) Namasivayam Rekha, MunuswamyDeecaraman and Ramachandran Balaji. Effect of Aqueous Extract of *Syzygiumcumini* Pulp on Antioxidant Defense System in Streptozotocin Induced Diabetic Rats. International Journal of Post Harvest Technology,2008; 7, 137-145.
- 14) Sepaha G. and Bose S., Clinical Observations on the Antidiabetic Properties of Pterocarpus marsupium and Eugenia jambolana. Journal of the Indian Medical Association, 1956; 27(11), 388-391.
- 15) Helmstadter A., *Syzygiumcumini*(L.) Skeels (Myrtaceae) Against Diabetes: 125 Years of Research. Pharmazie, 2008; 63(2), 91-101.
- 16) Karnic C.R., A clinical trial of a composite herbal drug in treatment of diabetic mellitus (madhumeha)., Aryavaidyan, 1991; 5, 36-46.
- 17) Bansal R., Ahmad N. and Kidwai J.R., Effects of oral administration of Eugenia jambolana seeds and chloropamide on blood glucose level and pancreatin cathepsis B in rat. Indian J. of Biochem and Biophys,1981; 18(5), 377.
- 18) Bose S.N. and Sepaha G.C., Clinical observation on the Antidiabetic properties of Petrocarpusmaruspium and Eugenia jambolana. Journal of Indian med. Assoc., 1956; 27(11), 388-391.
- 19) Achrekar S., Kaklij G.S., Pote M.S. and Kelkar S.M., Hypoglycemic activity of Eugenia jambolana and Ficus bengalensis : Mechanism of action. In vivo, 1991; 5(2), 143- 147.
- 20) Brito F.A., Lima L.A., Ramos M.F., Nakamura M.J., Cavalher-Machados S.C., Henrigues M.G. and Sampaino A.L., Pharmacological study of antiallergic activity of *Syzygiumcumini* (L) Skeels. Brazillian journal of medical and biological research ,2007; 40, 105-115.
- 21) Muruganandan S., Srinivasan K., Chandra S., Tandan S.K., Lal J. and Raviprakash V., Anti-inflammatory activity of *Syzygiumcumini* bark. Fitoterapia, 2001; 72(4), 369- 375.
- 22) Mahapatra P.K., Chakraborty D. and Chaudhari A.K.N., Anti-inflammatory and antipyretic activities of *Syzygiumcumini*. Planta Med, 1986; 52(6), 540.

- 23) Mukherjee P.K., Saha K., Murugesan T., Pal M. and Saha B.P., Screening for antidiarrhoeal profile of some plant extract of specific region of West Bengal, India. *Journal of Ethnopharmacology*, 1998; 60(1), 85-89.
- 24) Alok, R.; Akanksha, J. Enhancement of *Syzygiumcumini* (Indian jamun) active constituents by ultra-violet (UV) irradiation method. *Sci. Res. Essays* 2011, 6, 2457–2464.
- 25) Chhikara, N.; Kaur, R.; Jaglan, S.; Sharma, P.; Gat, Y.; Panghal, A. Bioactive compounds and pharmacological and food applications of *Syzygiumcumini*—A review. *Food Funct.* 2018, 9, 6096–6115.)
- 26) ( Sehwal, S.; Das, M. Composition and functionality of whole jamun based functional confection. *J. Food Sci. Technol.* 2016, 53, 2569–2579.
- 27) Singh, J.P.; Kaur, A.; Singh, N.; Nim, L.; Shevkani, K.; Kaur, H.; Arora, D.S. In vitro antioxidant and antimicrobial properties of jambolan (*Syzygiumcumini*) fruit polyphenols. *LWT-Food Sci. Technol.* 2016, 65, 1025–1030.)
- 28) (Kumar, R.; Khatkar, B.S. Thermal, pasting and morphological properties of starch granules of wheat (*Triticum aestivum* L.) varieties. *J. Food Sci. Technol.* 2017, 54, 2403–2410.)
- 29) (Awuchi, C.G.; Igwe, V.S.; Echeta, C.K. The functional properties of foods and flours. *Int. J. Adv. Res. Publ.* 2019, 5, 139–160)
- 30) (Marufa, M.A.; Das, P.C.; Iqbal, A. Utilization of Jamun seed powder in composite cake formulation. *J. Bangladesh Agric. Univ.* 2019, 17, 599–605.)
- 31) Nadkarni KM. *Indian materia medica*. Bombay: Popular Prakashan Ltd; 1976.  
Ratsimamanga U. Native plants for our global village. *TWAS Newslett* 1998; 10: 13-15.)
- 32) (Sagrawat H, Mann AS, Kharya MD. Pharmacological potential of *Eugenia jambolana*: a review. *Pharmacogn Mag* 2006; 2: 96-104)
- 33) Ayyanar, M.; Subash-Babu, P. *Syzygiumcumini* (L.) Skeels: A review of its phytochemical constituents and traditional uses. *Asian Pac. J. Trop. Biomed.* 2012, 2, 240–246.
- 34) Swami, S.B.; Kalse, S.B. Bioactive compounds in jamun (*Syzygiumcumini* L.) Skeels. *Pharma Innov. J.* 2020, 9, 161–167.