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PHARMACOGNOSY AND PHYTOCHEMISTRY OF SYZYGIUM CUMINI(JAMUN PLANT)- A REVIEW

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Syzygium cumini Skeels (Syn. Eugenia jambolana Lam.) 'Brahaspati' in Sanskrit, popularly known as Java plum, Portuguese plum, Malabar plum, Black plum, Indian blackberry, Jamun, Jambu, Jambul, Jambool and Naval belongs to the family Myrtaceae[1].

S. cumini is a large evergreen tree native to India. However, it is found in Eastern Africa, South America, Madagascar and warmer regions of the United States of America.[1,2]

Taxnomical description

Kingdom: Plantae Division: Angiosperms Sub Division: Eudicots Order: Myrtales Family: Myrtaceae Genus: Syzygium Species: cumini.

Macroscopy

S. cumini grows up to 15-30 m tall, with a straight to crooked, short, stout trunk (40-100 cm dia). Crown - irregular/ globular with branches; bark 1.0-2.5 cm thick; brown or dark grey in color; fairly smooth; astringent/ bitter taste. Twigs – light.

Leaves – margin is entire, narrow, transparent; size - 5-15 cm long, 2-8 cm broad; arrangement – opposite; appearance - thick, coriaceous, glabrous, upper surface dark green, lower surface yellowish and dull; shape – broadly obovate, elliptic or elliptic-oblong, base rounded; apex short, rounded or obtuse; edges not toothed; stalk - slender and light yellow, 1.5- 2 cm long; midrib-prominent, light yellow; veins - fine, close together, parallel, gland doted.

Flowers – clusters on old twigs at the back of leaves, 5-6 cm long and wide, with many paired stout forks at nearly right angles, end flower open first; flowers white, many, small, about 7 mm long, slightly fragrant, nearly stalk less, with cuplike, conical, light green base (hypoanthium) 3 mm long and broad; calyx with 4 white, rounded, concave petals, more than 2 mm long, united into a cap; stamens many, white or pinkish, threadlike, 5 mm long; pistil with inferior ovary; ovules numerous, tiny and stout; style white, 6- 7 mm long.[1]

Fruits – generally develop in the month of May to Jun and resemble large berries. The fruits are found in clusters of 4-20. However, all the fruits in an inflorescence do not ripe simultaneously. Fruits ovoid-oblong or elliptical berries, numerous, crowded in clusters, almost stalk less along twigs at the back of leaves; often curved, green at first, turning pink and then finally purple-black, 1-2.5 cm (max. 5) long with a centrally placed large seed; the pulp is grayish-yellow, white or pale violet. The ripen fruit has a combination of sweet, mildly sour and astringent flavor.[1] It is a rich source of Vit A and C.

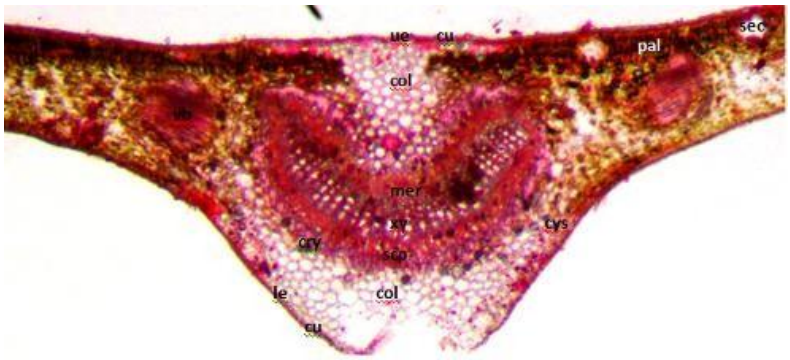
Seed – in each berry there is centrally placed seed, strongly astringent and slightly bitter, 1-2 cm long; sometimes 2-5 angular, irregularly shaped seeds are compressed together into a mass resembling a single seed. Cotyledons are pale green. Due to recalcitrant nature and short shelf-life-time, seeds cannot be stored viably for a long period of time.

Microscopy

The upper epidermis shows the presence of a single layer of wavy epidermal cells with striated cuticle. Palisade is made up of a single layer beneath upper epidermis in the lamina region and contains compact elongated cells. Spongy parenchyma is 5 to 8 layered. Spheraphide is distinctly visible in the lamina region between palisade cells and spongy parenchyma cells. Midrib shows the presence of collenchyma below the upper epidermis and above the lower epidermis. Vascular bundle (Xylem and phloem) are present in the center. Sclerenchyma is present in between the vascular bundle and collenchyma in the midrib region. Powder under a microscope showed different anatomical characters are shown in figure 2. Details of the characters recorded are given below the figure 3. Preliminary phytochemical screening of extract:

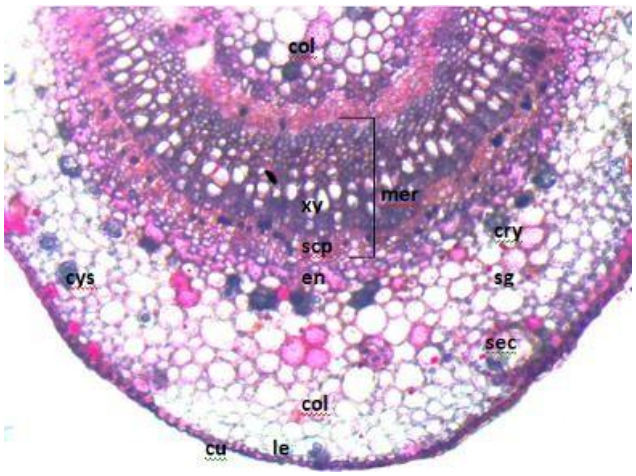
Preliminary phytochemical screening depicts the presence phytoconstituents as depicted below.

Figure 1: Leaves and plant of *Syzygium cumini* (L.) SKEELS.



Figer: 2a TS of leaf(dorsiventral) passing through midrib at 4X.

Upper epidermis (ue) covered with cuticle(cu), followed by single layered elongated palisade layer(pal) disrupted by secretory canal (sec) and spongy cells disrupted by vascular bundle(vb), centrally placed meristele (mer) i.e. forming an arc having lignified xylem(xy) towards upper surface arranged in radiating bands spreading towards lower surface, protoxylem pointing towards upper surface and phloem bands at lowe rside, va s cular bundl e cove red with sclerenchymatous pericycle bands(scp) and below to that endodermis, lower collenchymas shows deposition of crystal sheath (cry), starch grain (sg), cystolith (cys), below that lower epidermis (le) covered with cuticle(cu).



Figer 2b. TS of Leaf passing through midrib lower region at 10X.

Upper collenchyma (col), centrally placed meristele (mer) i.e. forming an arc having lignified xylem (xy) towards upper surface arranged in radiating bands spreading towards lower surface, protoxylem pointing

towards upper surface and phloem bands at lower side, vascular bundle covered with sclerenchymatous pericycle bands(scp) and below to that endodermis, lower collenchyma showing deposition of crystal sheath (cry), starch grain(sg), cystolith (cys) and secretory canal (sec), single layered lower epidermis (le) covered with cuticle (cu).

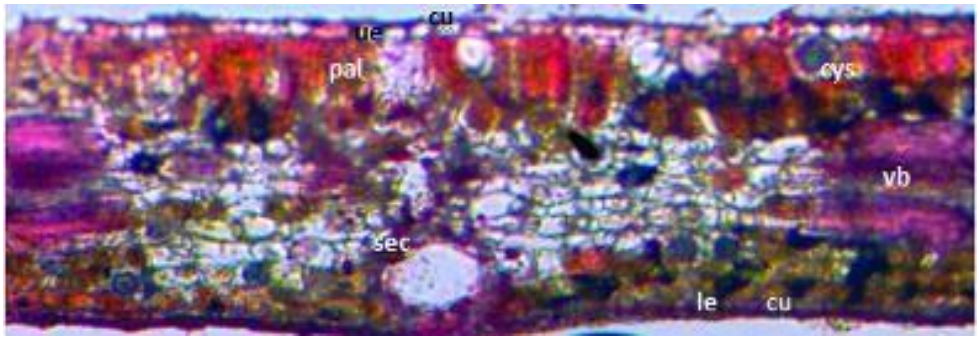


Figure 2c: TS of leaf (dorsiventrally) lamina at 10X.

Showing upper epidermis(ue) covered with cuticle(cu), mesophyll divided into single layered palisade(pal) layer and 7-8 layered spongy cells disrupted by secretory ducts (sec) and vascular bundles, cystolith (cys) and starch grain (sg) seen, single layered lower epidermis (le) covered with cuticle (cu)

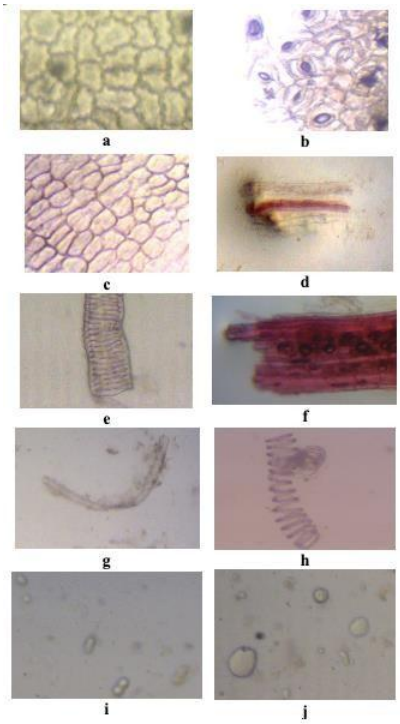


Figure: 3 Powder microscopy of *Syzygium cumini* (L.) SKEELS at 10X.

(a. Upper Epidermis (wavy epidermal cell in surface view), b. Lower epidermis with anisocytic stomata in surface view, c. Epidermis of Midrib (polygonal and non uniform) in surface view, d. Palisade cells with spherides and spongy cells in sectional view, e. pitted vessels, f. Calcium oxalate crystal sheath, g. Fragment of fibres and h. Spiral vessels, i. Simple and compound starch grain, J. Fixed oil).[3]

Table - Physico-chemical parameter.

S.No	Parameter Result
1	Loss on drying 5.26%
2	Total Ash Should not be more than 3.1 %
3	Acid insoluble ash Should not be more than 0.7 %
4	Water soluble extractiveShould not be less than 12.32%
5	Alcohol soluble extractive Should not be less than 10.96%

The data depicted in table is mean of three sample.

Phytochemical constituents

Jambolan is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaemferol and myrecetin. The seeds are claimed to contain alkaloid, jambosine, and glycoside jambolin or antimellin, which halts the diastatic conversion of starch into sugar and seed extract has lowered blood pressure by 34.6% and this action is attributed to the ellagic acid content.[4] The seeds have been reported to be rich in flavonoids, a well-known antioxidant, which accounts for the scavenging of free radicals and protective effect on antioxidant enzymes[5],[6] and also found to have high total phenolics with significant antioxidant activity[7] and are fairly rich in protein and calcium. Java plums are rich in sugar, mineral salts, vitamins C, PP which fortifies the beneficial effects of vitamin C, anthocyanins and flavonoids.[4]

Leaves

The leaves are rich in acylated flavonol glycosides[9] (Figure 1A), quercetin, myricetin, myricitin, myricetin 3-O-4-acetyl-L-rhamnopyranoside[10] (Figure 1B), triterpenoids[11], esterase, galloyl carboxylase[12], and tannin.[4] The leaves of Jamun were found to contain betulinic acid, crategolic acid, n-dotricontanol, n-hentriacontane, n-hepatcosane, mycaminose, myricetin, myricitrin, myricetin 3-O- (4″-acetyl)-α-L-rhamnopyranosides, n-nonacosane, quercetin, β-sitosterol, noctacosanol, n-triacontanol, triterpenoids, tannins, eicosane, octacosane and octadecane.[1, 22–25]

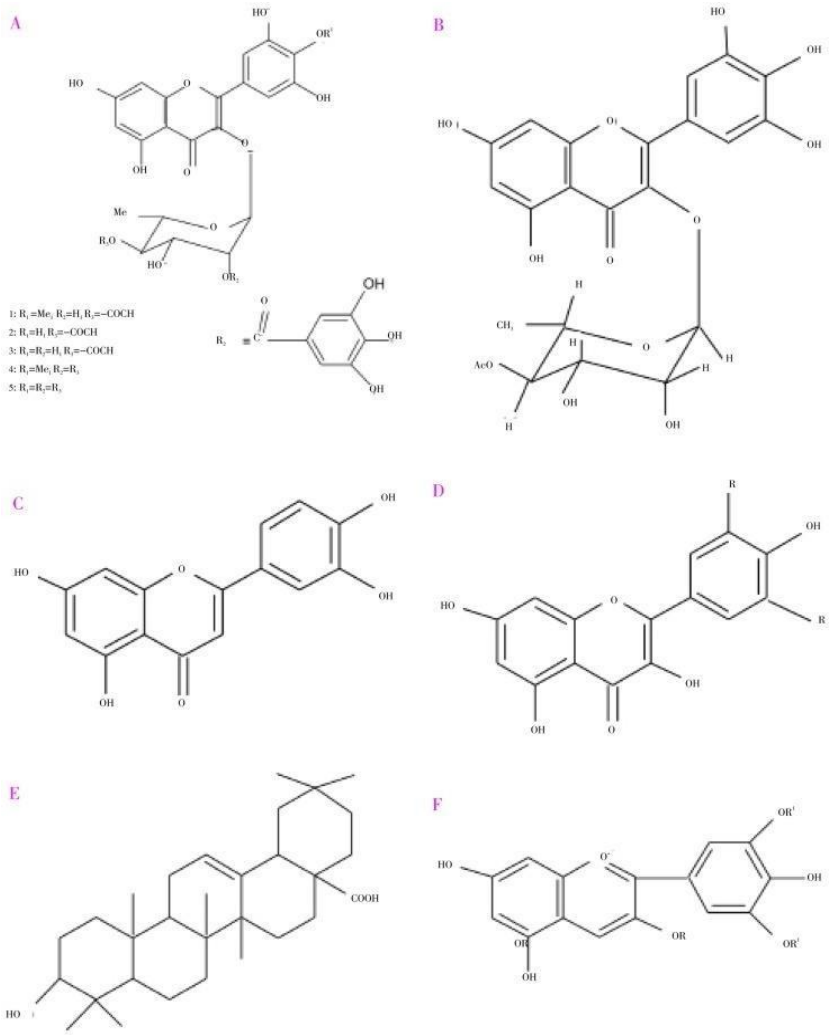


Figure 4.

Phytochemical constituents isolated from S. cumini (L.) Skeels.

A: Mearnsetin -3-O-(400-O-acetyl)-a-L-rhamnopyranoside (1), myricetin 3-O- (400-O-acetyl-200-O-galloyl)-a-L-rhamnopyranoside (2), myricetin 3-O-(400-O- acetyl)-a-L-rhamnopyranoside (3), myricetin 40-methyl ether 3-O-a-l- rhamnopyranoside (4), myricerin (5); B: Myricetin 3-O-(4″-acetyl)-α-L-rhamnopyranoside; C: Quercetin; D: Kaempferol R=H; Myricetin R= OH; E: Oleanolic acid; F: Delphinidin-3-gentiobioside R = Gentiobiose, R1 = H: Malvidine-3-laminaribioside R = Laminaribiose R1 = Me.

Stem bark

The stem bark is rich in betulinic acid, friedelin, epi-friedelanol, β-sitosterol, eugenin and fatty acid ester of

epi-friedelanol[13], β-sitosterol, quercetin kaempferol, myricetin (Figure 1C and Figure 1D), gallic acid and ellagic acid[14], bergenins[15], flavonoids and tannins.[16] The presence of gallo- and ellagi-tannins may be responsible for the astringent property of stem bark.

Flowers

The flowers are rich in kaempferol, quercetin, myricetin, isoquercetin (quercetin-3- glucoside), myricetin-3-L-arabinoside, quercetin-3-D-galactoside, dihydromyricetin[17], oleanolic acid (Figure 1E), acetyl oleanolic acid, eugenol- triterpenoid A and eugenol-triterpenoid B.[17]

Roots

The roots are rich in flavonoid glycosides[18] and isorhamnetin 3-O-rutinoside.[19]

Fruits

The fruits are rich in raffinose, glucose, fructose[20], citric acid, mallic acid[21], gallic acid, anthocyanins[22]; delphinidin-3-gentiobioside, malvidin-3-laminaribioside, petunidin-3-gentiobioside[23] (Figure 1F)[23], cyanidin diglycoside, petunidin and malvidin.[24] The sourness of fruits may be due to presence of gallic acid. The color of the fruits might be due to the presence of anthocyanins.[23] The fruit contains 83.70–85.80 g moisture, 0.70–0.13 g protein, 0.15–0.30 g fat, 0.30–0.90 g crude fiber, 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, 0.23 mg copper, 13.00 mg sulfur, 8.00 mg chlorine, 80 I.U. 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 per 100 g of edible portion.[25] One of the variety of jambolan found in the Brazil possesses malvidin-3-glucoside and petunidin-3-glucoside.[26] The peel powder of jambolan also can be employed as a colorant for foods and pharmaceuticals and anthocyanin pigments from fruit peels were studied for their antioxidant efficacy stability as extract and in formulations.[27]

Essential oils

The essential oils isolated from the freshly collected leaf (accounting for 82% of the oil)[28], stem, seed, fruits contain α-Pinene, camphene, β-Pinene, myrcene, limonene, cis-Ocimene, trans-Ocimene, γ-Terpinene, terpinolene, pinocarvone, pinocarveol bornyl acetate, α-Copaene, β-Caryophyllene, α-Humulene, γ-Cadinene and δ-Cadinene[32], trans-ocimene, cis-ocimene, β-myrcene, α-terpineol, dihydrocarvyl acetate, geranyl butyrate, terpinyl valerate[29], α-terpineol, β- caryophyllene, α-humulene, β-selinene, calacorene, α-muurolol, α-santalol, cis- farnesol: lauric, myristic, palmitic, stearic, oleic, linoleic, malvalic, sterculic and vernolic acids.[30] Unsaponifiable matter of the seed fat was also chemically investigated.[31]

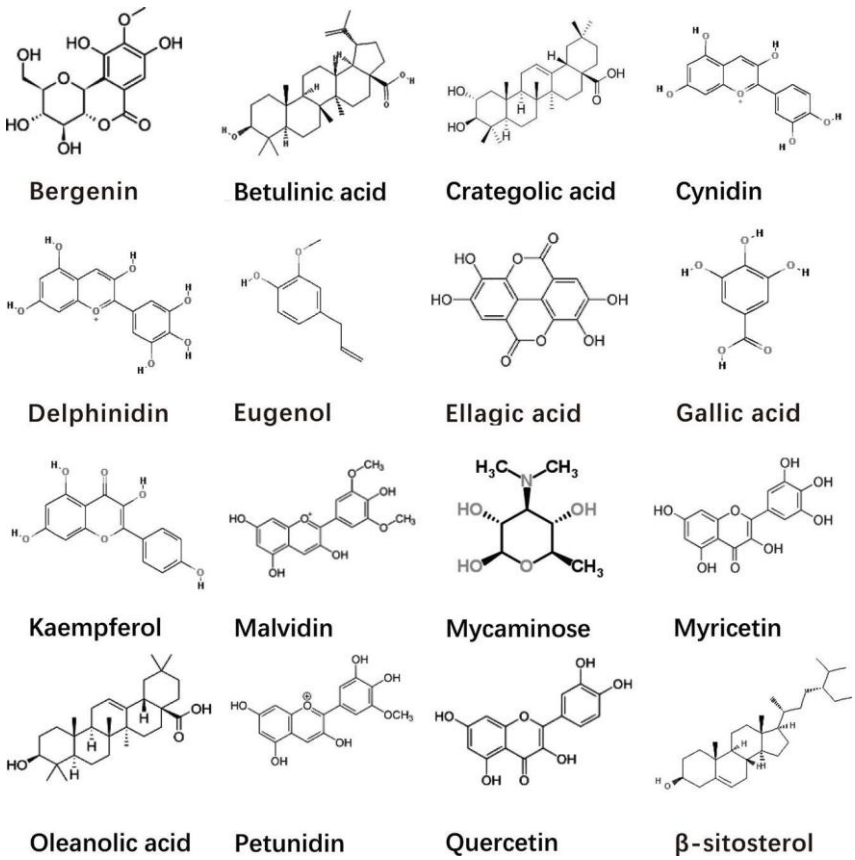


Figure 5.

Chemical structures of some important phytochemicals present in different parts of Jamun, *Syzygium cumini.*

CONCLUSION

The Jamun (Syzygium cumini) belonging to family Myrtaceae has been used in traditional medicine for treatment of different ailments, including diabetes. The studies including Transverse section, longitudinal section, powder microscopy and physico- chemical properties of drug help us in evaluating of crude jamun plant. The plant has many important compounds which confer the most of the characteristics of the plant. Phytochemical evaluation has shown that Jamun contains alkaloids, anthroquinone glycosides, flavonoids, tannins, saponins, phenols, cardiac glycosides, terpenoids, phytosterols, steroids and amino acids. Phytochemicals present in drug have showen many pharmacological activity like antioxidant and anti-inflammatory antidiabetic, Antibacterial and antifungal activity, Antiallergic activity. The review have made us to understand the pharmacognosy and phytochemistry of jamun plant.

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