Medicinal Potential of Jamun (Syzygium cumini Linn): A Review

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ABSTRACT

Unani System of Medicine (USM) is being practised as traditional, alternative and complementary medicine in India and other countries. In this system of medicine, medicinal plants are extensively used in the treatment of various kind of diseases since time immemorial. Herbo-mineral origin drugs are the main components of Unani Pharmacopoeia. Jamun (Syzygium cumini Linn) is one of the medicinal plants used for therapeutic purposes in Dhayabhūtis Hārr (diabetes mellitus), Ḩāsid-е- Damwī (haemorrhagic diarrhoea), Ḩisāal-и-Safrāwī (bilious diarrhoea), DuṬ al-ISHīH (loss of appetite), Zāhīr (dysentery) and Qalū (oral ulcer). In recent past its fruits, seeds, leaves, stem bark and its secondary metabolites have shown medicinal properties in various experimental and clinical studies. In this review we have tried to explore its ethnomedicinal and pharmacological actions described in classical literature and scientific publications based on experimental studies. It is found that this plant plays an important role in prevention and management of non-communicable diseases such as Dhayabhūtis Hārr (diabetes mellitus), Sartān (cancer), Ṣiqrīs (gout), ischemic heart disease etc. Several preclinical studies have revealed that it has Muḥbhīl-и- Awrām (anti-inflammatory), Muḥāfīz-и- Qalū (cardio protective), Daфи-и- Ḩummā (anti-pyretic) and Muqawwūt-и-Jīgār (hepatotonic) properties. It also possesses anti-diabetic potential activity and considered as a potent anti-diabetic plant.

Keywords: Unani, Jamun, ʿSyzygium, Anti-diabetic, Anti-inflammatory, Hepatoprotective

Introduction:

Unani System of Medicine (USM) is being practised as traditional, alternative and complementary medicine in India and other neighbouring countries. Unani pharmacopoeia is enriched with herbo-mineral single drugs and their formulations. Jamun (Syzygium cumini Linn, Syn. Eugenia jambolana Lam.), is one of the important medicinal plants having potential to treat several ailments successfully. It is found that this plant plays an important role in prevention and management of non-communicable diseases such as Dhayabhūtis Hārr (diabetes mellitus), Sartān (cancer), Ṣiqrīs (gout), ischemic heart disease (IHD) etc. In Unani System of Medicine, this plant is described as Qābilād (stringent), Kāsir-ī-Riyāh (carminative), Mutdrīr-ī-Bawāl (diuretic), Daфи-ī-Dhayabhūtis (anti-diabetics), Sāyālān al-Rāḥīm (leucorrhoea), Daфи-ī-Ḥummā (antipyretics) and Qurāb (wound). This plant is a large evergreen tropical glabrous tree and consists of about 90 genera and 2,800 species. Its existence is described by Ibn Batuta who visited India in 1332, A.D. as one of the fruits of Delhi. It is found throughout in India and other countries like Nepal, Myanmar, Sri Lanka, Indonesia, Pakistan, Bangladesh, Malaysia, Thailand, Philippines, Australia and other tropical regions of the world including South America and Madagascar since ancient time. Its different parts have been indicated in different ailments and its therapeutic application varies according to system of medicine. In Unani medicine, its seed kernel, commonly known as Khasta Jamun, is used for the management of diabetes mellitus. There are many compound formulations in which Jamun is added as one of the constituents of the formulation. Safooī-ī-Khasta, Safooī-ī-Ziyābethus and Qursī-ī-Zābātes are some important compound formulations indicated for diabetes mellitus. It may emerge as a potent antidiabetic plant.
Scientific Classification (6, 5):

It is known by various names in different vernaculars such as:

<table>
<thead>
<tr>
<th>English</th>
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<tr>
<td>Hindi</td>
<td>Jamun</td>
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<td>Urdu</td>
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Morphological characteristics:

It is a large evergreen glabrous tree up to 30 meters height and girth of 3.6 meters. It is also considered as fast growing tree, reaching full size in 40 years. It ranges up to 100 ft. (30 m) in India and it may attain a spread of 30 ft. (11 m) and a trunk diameter of 2 or 3 ft. (0.6-0.9 m). (14)

Bark: It is pale brown, slightly rough on old stems with shallow cracks. (9) The bark on the lower portion of the stem is rough, cracked, flaking, and discoloured while it is light gray to grayish-brown and smooth toward the upper portion. (15)

Leaves: They are variable, usually 7.5-15 by 3.8-6.3 cm. lanceolate, elliptic-oblong or broadly ovate-elliptic, acute, acuminate or sub obtuse, coriaceous, smooth and shining above, with numerous close parallel fine secondary nerves uniting to form an intramarginal vein. (16)

Flowers: The flowers do not exhibit much variation except in colour. They may be white to creamy white or occasionally slightly green. The flowers are borne in clusters of a few to 40 in number on terminal or axillary panicked racemes. (16) Flowers are 7.5-13 mm. across, whitish, fragrant, sessile arranged mostly in threes in tricobotinous panicles 3.8-10 cm. long which usually appear from the scars of fallen leaves. (9) The flowering starts in March and continues until May. Full blooming occurs in April to May. (16)

Fruit: Its fruit is a berry, which initially appears green, and gradually turn to light violet-red or purplish-red, and finally dark purple to black at full maturity. In most of the habitats, the fruiting starts in May and bunches of young fruits appear after 15-25 days from fruit initiation. Unripe mature fruits appear about 30-40 days after flowering. (16)

Parts Used: Unani classical literature describes its different parts having medicinal values. It has been used in multiple dosage forms for various therapeutic purposes. Its different parts such as Leaves (7, 8, 13, 19, 20), Stem bark (7, 8, 13, 17, 19, 20, 21), Fruit (7, 8, 13, 18, 19, 20, 21), Seeds kernel (7, 8, 17, 18, 19, 20, 21), Flower (19, 20), and roots (7) are being used in traditional medicine for the treatment of various ailments.

Dosage: In classical literature, the dosage of its seed kernels is 1-3(18, 22) or 2 gms (21) per day orally. But Unani Pharmacopoeia of India describes the oral dose of seed kernel as 3-5 gms per day (17) but dosage of the leaves is 5-10 gms per day.

Adverse effects: As reported in classical literature, this drug sometimes causes flatulence, delayed digestion (18, 21, 23), inflamed larynx and lungs (22, 23) and emphysema as side effect. (13) Common salt and Fīlīl Siyah (Piper nigrum) may be used as corrective to minimize the side effects. (18, 21, 23, 24)

Ethno-botanical therapeutic uses:

Stem bark: Its bark has medicinal value and is used as digestive, Qābīd (astringent) (6), and anthelmintic to the bowels. (6) It is indicated in classical literature for Istīhāb al-Shu‘āb (bronchitis), Rābu (bronchial asthma), Zaḥīr (dysentery), Najis-i-Dam (blood impurities) and Qurāb (ulcers). (6)

Seed: The seeds are known as good Qābīd (astringent) to the bowels, 6 Muhālil-i- Awarām (anti-inflammatory), anti-arthritis, Daft-i-Hummā (anti-pyretic) and Musakkān-i-Alam (analgesic). (11) It is indicated as Daft-i-Dhayābūtūs (antidiabetic agents) in Dhayābūtūs Ḩārr (diabetes mellitus). (11) It diminishes the quantity of sugar in urine and allays the unquenchable thirst of diabetics. (6) The seed is also used in Duʃ al-Mūda (weakness of stomach), Duʃ al-līgar (weakness of liver), Musakkin-i-Soṣāz and Ishāl-i-Damwī wa Ṣafārwī (haemorrhagic and bilious diarrhoea). (17)

Leaves: Its leaves are also used as Qābīd (astringents) in Zaḥīr (dysentery) (6) and Muhālil-i- Awarām (anti-inflammatory) in Quil (stomatitis). It has been used in the treatment of vomiting and haemorrhoids. It is also used as anti-venom. (13) The ash of leaves is used for strengthening the teeth and the gums. (6) Decoction of an equal amount of its stem bark and leaves subsides the smell of armpit. They are used as a paste to subside the burning sensation of the body in case of burn. (13)

Fruits: The fruits are considered as a general tonic. They are used as tonic to the liver and enrich the blood. They strengthen Asnān-o-Līthā (teeth and gums) and act as Qābīd (astringent) in Ishāl-i- Ṣafārwī (bilious diarrhoea). They are also used in sore throat and ringworm in the head. (6) The vinegar made of the fruit is tonic, Muqawwāt-i-Mudā (stomachic), Qābīd (astringents) and kāsīr-i-Riyāḥ (carminative). (6, 8) It is useful in diseases of the spleen. (8) It is also used as a Mudīr-i-Bawla (diuretic) and Daft-i-Dhayābūtūs (antidiabetic). (6, 8) The fruits are a good source of iron, used as an effective medicine against heart diseases, liver diseases and asthma. (11)

Therapeutic Uses:

In Unani literature this plant has been indicated for various ailments in different dosage form. Those indications are summarised below.

1. Zaḥīr (Dysentery) (2, 12, 13, 18, 24, 26)
2. Ishāl-i- Damwī (Haemorrhagic diarrhoea) (9, 12, 13, 17, 18, 21, 23, 24)

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3. *Is'hāl-i- Šafārāvī* (Bilious diarrhoea) (2,9,12,13,17,18,21,24,26)
4. *Du'f al-Mīdrā* (Weakness of stomach) (2,18,21,23)
5. *Warm-e- Tīhāl* (Splenitis) (18,23)
6. *Dhayābūtis Ḥārā* (Diabetes mellitus) (9,11,12,18,21,25,26)
7. *Qulā* (Oral ulcer / Stomatitis) (13,24,26)
8. *Hummā* (Fever) (6,8,13,24)
11. Bacterium (25)
14. Cholecystosis (13,24,25)
17. *Dhīmūn* (Oedema) (25)
18. *Gakstone* (25)
19. *Niqrīs* (Gout) (25)
20. *Bawal al-Dam* (Haematuria) (25)
22. *Hasāt-i- Kultya* (Kidney Stone) (25)
23. *Low Blood Pressure* (25)
25. *Hudār* (Rheumatism) (25)
26. *Sujan* (Swelling) (25)
27. *Bandāsh-i- Ḥdār* (Water/ Urine Retention) (25)
29. *Du'f al-Ishthā* (Loss of appetite) (13,18,21,24)
30. *Hassāsīyat* (Allergy) (18)
31. *Qāṭī-i-Bāh* (Anaphrodisiac) (13,22,24)
32. *Du'f al lithā* (Weakness of gums) (17)
33. *Dā al-Tha'lab* (Alopecia Areata) (6,13,24)
34. *Sore throat* (6,13,24)
35. *Ilīhāb al-Shu'āb* (Bronchitis) (6,13,24)
36. *Rabw* (Bronchial Asthma) (6,13,24)
37. *Najīs-i-Blood* (Blood Purifier) (13,24)
38. *ʿUtāsh Mufrīt* (Polydipsia) (13,24)
39. *Riyāḥ* (Flatulence) (13,24)

**Pharmacological Actions:**

This plant has been described in various classical literature of Unani medicine as a single drug and its actions have been described as follows.

1. *Daft-i-Ḥumā* (Anti pyretic) (13,18,21,24)
2. *Qābād* (Astringent) (2,6,9,13,18,21,22,24,25)
3. *Kāsīr-i- Riyāḥ* (Carminative) (2,6,8,12,13,24,25)
4. *Mushtahī* (Appetizer) (13,18,21,24)
6. *Qoat-i-Šafār* (Anti-bilious) (6,9,13,22,24)
7. *Daft-i-Dhayābūtis* (Anti diabetic) (2,6,9,11,12,13,14,24,25,26)
8. *Muqawwāl-i-Jīgar* (Hepatotonic) (11,13,18,21,23,24)
11. *Muḥāfiz-i- Qalb* (Cardio-protective effects) (18)
12. *Daft-i-Is'hāl* (Anti-diarrheal effects) (12,17,26)
13. *Daft-i-Iḥassāsīyat* (Anti-allergic effects) (22)
15. *Tiryāq* (Antidote) for nux-vomica (25)
20. *Muqawwāth-i-Mīdrā* (Stomachic) (2,6,9,12,13,17,18,21,22,23,24)
21. *Mudīrī al- Bawl* (Diuretic) (2,6,9,12,25)
22. *Uqr* (Sterility) (11)
23. *Musaffī-i-Dam* (Blood Purifier) (13,22,24)
24. *Muqawwiyāt-i- Assān-o-Litha* (Strengthen the gums and teeth) (12,24)
25. *Khaṣṣāqān* (Palpitation) (13,24)

**Chemical constituents:**

Phytochemical studies have conducted and various chemical constituents have been isolated from different parts of the plant.

**Seed:** It contains tannin (19%), ellagic acid (3,12) gallic acid (1-2%), glycoside (jambuic acid), starch and small quantity (0.95%) of a pale-yellow essential oils (3,12) chlorophyll, fat, resin, albumin, hexahydroxydiphenoxy-glucose and its isomer hexahydroxydiphenoxyphane, 1-galloylgucose and elements such as zinc, chromium, vanadium, potassium and sodium.

**Fruit:** It contains anthocyanins, citric, malic and gallic acids, glucose and fructose (12), and oxalic acid. It is reported that the colour of the fruits might be due to the presence of anthocyanins namely delphinidin-3-gentiobioside and malvidin-3- lamarinibioside along with petunidin-3- gentiobiosid.

**Leaves:** Aliphatic alcohols, sitosterol, betulinic acid, crategolic acid (12). Quercetin (0.0085%), myricetin (0.023%), myricitrin (0.009) and myricitrin 3-O-4’-acetyl. α-L-rhamnopyranoside (0.05%) are found in it.

**Flower:** It contains triterpenic acids- oleanolic acid (3) and oleanolic acid (12). Three triterpenoids are reported to be present in the flower. One of these is acetyl oleanolic acid, the other two designated euca-tryperpenoid A, and Eugenia triterpenoid B have not been identified. The flowers also contain flavonoids isoorcetin, quercitin, kaempferol and myricetin, ellagic acid.

**Stem bark:** It contains beta-sitosterol, gallic acid- friedelin, betulinic acid, tannins (12%), ellagic acid and myricetin. (3)
Pharmacological activities:

1. Hypoglycaemic activity: In a study conducted by Madhuri Pandey and Aqueel Khan it revealed that feeding of diets containing 15% unextracted (intact), 15% defatted S. cumini seeds and 6% watersoluble gummy fibre for 21 days significantly lowered (26-28%) the blood glucose level and significantly improved glucose tolerance in both normal and diabetic rats when compared with their respective control. This study suggest that S. cumini seed diets have hypoglycaemic activity. (29)

2. Anti-inflammatory activity: Muruganandam et al in their experimental study showed that 70% ethanolic extract of S. cumini bark had significant anti-inflammatory activity comparable to that of acetylsalicylic acid (300 mg/kg/oral). (30) It proves that it has as a good anti-inflammatory property.

3. Cardio-protective activity: The hydro-alcoholic extract from the fruits of S. cumini was evaluated for its antihypertensive and vasorelaxant effect in the study conducted by Herculano et al. Its results suggested that extract induced hypotension and caused antihypertensive effects. (31) This result justifies the application of the fruits of this plant as cardioprotective drug.

4. Antiretinitis: Priya et al. (2013) studied the binding affinity of five anthocyanin compounds from S. cumini fruit peel with the X-linked retinitis pigmentosa (RP2) gene [a mutant of this gene causes loss of vision in humans] and revealed cyanidin 3, 5 diglucoside with lowest G score (-12.62 kcal/mol) as an inhibitor that could be of potential use in the treatment of retinitis pigmentosa in humans. (32)

5. Antipyretic activity: In an experimental study Mahapatra et al reported that seed extract of S. cumini had anti-inflammmatory and anti-pyretic activity evaluated in adult male Charles-Foster rats (120-160 g). The seed extract (50, 100 and 200 mg/kg, i.p.) produced significant antipyretic activity against yeast induced pyrexia in rats. (33, 34)

6. Anti-Diarrhoeal Activity: It has been used for controlling diarrhoea since a long time. A study reported that bark extract of Eugenia jambolana Lam. had significant inhibitory activity against Castor oil-induced diarrhoea in experimental animal models. (35)

7. Hepatoprotective activity: It possesses hepatoprotective property as reported in the literature. Das and Sarma in their study reported that the Ethanol Extract of The Pulp of Eugenia Jambolana Lam. at doses of 100mg/kg and 200mg/kg possess significant Hepatoprotective activity in rats induced with hepatotoxic paracetamol. (36) In another study it was revealed that the methanolic extract of Eugenia Jambolana Lam. at an oral dose 400mg/kg/day, was effective against the hepatotoxicity which was caused by carbon tetrachloride (CCL4). (37)

8. Anti-Cancer Activity: For Sarthi (cancer) treatment, nine plant-derived compounds have been approved for clinical use in the United States. They include vinblastine, vincristine and paclitaxel. There are few reports that have revealed the potential role of Syzygium cumini (L) fruits to combat cancer. (19)

Anthocyanin-rich Java plum fruit extract (JPE) clearly demonstrated the anti-cancer properties not only against the early stage HCT-116 human colon cancer cells but also induced apoptosis and inhibited self-renewal ability in colon cancer stem cells (CSCs). (30) Mittal et al developed and characterized silver nanoparticles (AgNPs) of Syzygium cumini (L) fruit extract in vitro. The size of newly synthesized silver nanoparticles and their size were observed to be 10-15 nm. Important findings of this study were the recognition of biomolecules accountable for the synthesis of silver nanoparticles and the mechanism of biosynthesis. Presence of flavonoids in Syzygium cumini (L) was mainly responsible for the reduction and stabilization of nanoparticles. The nanoparticles were observed to devastate Dalton lymphoma cell lines in vitro. Silver nanoparticles (100μg/mL) were found capable to reduce Dalton lymphoma (DL) cell lines viability up to 50%. (39)

9. Anti-Leishmania activity: In a study, Rodrigues et al examined the effects of Syzygium cumini (L) essential oil (ScEO) and its major component α-pinene on Leishmania (Leishmania) amazonesis. Anti-proliferative effect on Leishmania, effects on promastigote and axenic amastigote forms were assessed using tetrazolium salt (MTT) assay. The intramacrophagic amastigotes were exposed to ScEO and α-pinene to evaluate the survival index. Results revealed that α-Pinene was effective against Leishmania amazonesis promastigote forms, having 50% inhibitory concentration (IC50) value of 19.7 μg/mL. α-Pinene was more active (IC50 values of 16.1 and 15.6 μg/mL against axenic and intracellar amastigotes, respectively) than ScEO (IC50 values of 43.9 and 38.1 μg/mL against axenic and intracellar amastigotes, respectively). (40) This report suggests that it may be used in prevention and treatment of Leishmaniasis.

10. Antihyperlipidemic Activity: Kasipan et al. in their study showed oral administration of ethanolic extract of E. jambolana-kernel (100mg/kg body weight) had antihyperlipidemic activity on streptozotocin induced diabetic rats. (41)

11. Antinaemic activity: It has been reported that aqueous seeds extract of S. cumini possessed antinaemic activity. In a study it revealed that seed extract of the S. cumini increased total haemoglobin. (42)

12. Antibacterial activity: Bhiyian et al. in their study showed that methanol and ethyl acetate extracts of the seeds of E. jambolana at a concentration of 200 μg/disc showed antibacterial activity against Bacillus cereus, B. subtilis, B. megateriun, Streptococcus β-haemolyticus, S. aureus, Shigella dysenteriae, Sh. Shiga, Sh. boydii, Sh. flexneriae, Sh. sonnei, E. coli, S. typhi B, S. typhi and Klebsiella species. (43) An extract of the leaves of the E. jambolana also showed moderate antibacterial activity against Escherichia coli and antibiotic activity against Micrococcus pyogenes var. aureus. (3)

13. Anti-fertility Activity: Rajasekaran et al has reported anti-fertility activity of oleic acid isolated from the flowers of E. jambolana. It decreased the fertilization capacity of the male albino rats without any significantly change in body or reproductive organ weights. It caused significant reduction in conversion of spermatocytes to spermatid and arrest of spermatogenesis at the early stages of meiosis leading to decrease in sperm count without any abnormality to spermatogenic cells, leading interstitial cells and sertoli cells. (44)

14. CNS Protective Activity: Kumar et al. investigated the ethyl acetate and methanol extracts of the seeds of S. cumini for CNS activity on albino mice at dose levels of 200 and 400 mg/kg. Both extracts exhibited significantly CNS protective activity. (45)

15. Antinephrotoxic Activity: Adilay et al. studied the nephroprotective activity of an ethanol extract of fruits of S. cumini (250 and 500 mg/kg taken by mouth) on cisplatin-
induced nephrotoxicity (6 mg/kg intraperitoneally) in albino rats. The nephroprotective activity of *S. cumini* was assessed by estimating the levels of blood urea nitrogen, serum creatinine, serum total proteins, urinary protein, and lipid peroxidation in the kidney. Cisplatin elevated the serum marker level, increased the protein excretion in urine, reduced the creatinine clearance, and increased the renal MDA level. Animals that received an ethanolic extract of fruits of *S. cumini* significantly reversed the effects induced by cisplatin in a dose-dependent manner. (46)

16. Radio protective Effect: The leaves of *S. cumini* were tested as a radioprotectant using a micronucleus assay. *S. cumini* was found to reduce the formation of micronuclei in lymphocytes. (47) Arun et al. also confirmed that seed extracts of *S. cumini* inhibited the micronuclei formation in mouse bone marrow cells induced by genotoxic stress. Similar to previous observations, *S. cumini* extract reduced the incidence of micronuclei, and a concentration-dependent inhibition of lipid peroxides was also observed in mice brain extract prepared after irradiation. (48)

17. Immunomodulatory Activity: Seed extract of *S. cumini* was studied for its immunomodulatory activity. It was found to increase the delayed-type hypersensitivity (DTH) reaction and humoral antibody titres in rats in a dose-dependent manner. Similarly, the treatment also increased the total number of white blood cells, neutrophils, and lymphocytes in rats. (49) This study pointed out that *S. cumini* seed extract had the potential to stimulate the hematopoietic system of the body, which, in turn, indicated that the plant had treatment potential in immune-deficient conditions arising during radiation therapy or chemotherapy.

18. Antioxidant Activity: Zhi-Ping et al. investigated the antioxidant activity of *S. cumini* leaf extracts using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging and ferric reducing antioxidant power (FRAP) assays. In this study, the results showed that the ethyl acetate fraction had stronger antioxidant activity than the other ones. High-performance liquid chromatography (HPLC) data indicated that *S. cumini* leaf extracts contained phenolic compounds, such as ferulic acid and catechin, responsible for their antioxidant activity. (50)

**Conclusion:**

Jamun (*S. cumini*) is one of the known herbal medicinal plants in Unani system of medicine (USM). Its various parts such as fruits, seeds (*Ficus*), leaves and bark possess medicinal values. It is commonly used as anti-diarrhoeal, digestive, astringent and antibacterial drug. In classical literature, it is indicated for *Du'af al-Mida* (weakness of stomach), *Ishāl-e-Damāwi* (haemorrhagic diarrhoea), *Ishāl-e-Safrawi* (bilious diarrhoea) and *Dhayāl hārr* (diabetes mellitus). In several experimental studies, it has been reported that it possesses *Daft-i-Dhayāl hārr* (anti-diabetic), *Muhallil-i-Avrām* (anti-inflammatory), *Daft-i-Jarāsīm* (antibacterial) and *Daft-i-Humāmā* (anti-pyretic) actions. Its encouraging result reported in various preclinical studies suggested that it may be used as a study drug in clinical trial to test its efficacy as *Daft-i-Dhayāl hārr* (anti-diabetic), *Muhallil-i-Avrām* (anti-inflammatory), *Daft-i-Jarāsīm* (antibacterial) and *Daft-i-Humāmā* (anti-pyretic) potential. Its future, clinical studies should be designed to validate and document the efficacy of its various parts as described in classical literature so that it can be used as a potential drug to treat and manage non-communicable diseases. Such studies may help in bringing USM into mainstream that is one of the objective of National Health Policy 2017.


