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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 *Dhayābīṭus Ḥārr* (diabetes mellitus), *Ishāl-e- Damwī* (haemorrhagic diarrhoea), *Is'haal-i-Safrāwī* (bilious diarrhoea), *Ḍu'f al-Ishtihā'*(loss of appetite), *Zaḥīr* (dysentery) and *Qulā* (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 ethno-botanical uses 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 *Dhayābīṭus Ḥārr* (diabetes mellitus), *Sarṭān* (cancer), *Niqris* (gout), ischaemic heart disease etc. Several preclinical studies have revealed that it has *Muḥallil-i- Awrām* (anti-inflammatory), *Muḥāfiẓ-i- Qalb* (cardio protective), *Dafi'-i-Ḥummā* (anti-pyretic) and *Muqawwī-i-Jigar* (hepatotonic) properties. It also possesses anti-diabetic potential activity and considered as a potent anti-diabetic plant.

Keywords: Unani, Jamun, Syzygium, Antidiabetic, Anti-inflammatory, Hepatoprotective

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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 *Dhayābīṭus Ḥārr* (diabetes mellitus), *Sarṭān* (cancer), *Niqris* (gout), ischaemic heart disease (IHD) etc. In Unani System of Medicine, this plant is described as *Qābiḍ* (astringent), *Kāsir-i-Riyāḥ* (carminative), *Mudirr-i-Bawl* (diuretic), *Dāfi'-i-Dhayābīṭus* (antidiabetics), *Sayalan al-Raḥim* (leucorrhoea), *Dafi'-i-Ḥummā* (antipyretics) and *Qurūḥ* (wounds).[3]

This plant is a large evergreen tropical glabrous tree and consists of about 90 genera and 2,800 species. [1] Its existence is described by Ibn Batuta who visited India in 1332, A.D. as one of the fruits of Delhi. [2] 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.[3]

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. Safoof -i- Khasta, Safoof-i- Ziyābetus and Qurs-i-Ziābetus are some important compound formulations indicated for diabetes mellitus. It may emerge as a potent antidiabetic plant.

Scientific Classification [4, 5]:

Its taxonomy is tabulated in table- 1.

Table- 1: Scientific classification of Jamun

Kingdom	*Plantae*
Division	*Magnoliophyta*
Class	*Magnoliopsida*
Order	*Myrtales*
Family	*Myrtaceae*
Genus	*Syzygium*
Species	*cumini*

Vernaculars names: It is a very popular plant medicine but it is known by various names in different vernaculars such as:

Urdu: Jaman, [6, 7] Phalenda [6]

Hindi: Jam,[3,6,8]Jamun, [6,9,10,11] Jaman,[3,6,7,8, 10] Phalanda,[6] Phalinda[6,8]

English: Black plum, [6, 8, 10, 12] Black Berry [8]

Sanskrit: Jambula, [6, 8] Jambu [6, 8, 9, 12, 13]

Telugu: Neereedu, [3] Neredu, [6, 11] Jambuvu, [6, 9] Naeraedu, [8]Nesedu[10]

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 36 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. [6] The bark on the lower portion of the stem is rough, cracked, flaking, and discoloured while it is light gray to gray or 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.[6]

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 panicled racemes. [16] Flowers are 7.5-13mm. across, whitish, fragrant, sessile arranged mostly in threes in tricotomous panicles 3.8-10 cm. long which usually appear from the scars of fallen leaves. [6] 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], 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.

Temperament: Some Unani physicians described its temperament as Bārid[2] Yābis[1or 2] (Cold and Dry) [13, 20, 22] or Bārid[3] Yābis[2] (Cold and Dry) [13] and some mentioned its temperament as Bārid [2] Yābis[3] (Cold and Dry) [23, 24] but Hakim Najmul Gani described the temperament of this plant as Bārid[2] Raṭb[1] (Cold and Moist) and that of seed is Bārid[2] Yābis[2] (Cold and Dry). [24]

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], inflammed larynx and lungs [22, 23] and emphysema as side effect. [13] Common salt and Filfil Siyah (*Piper nigram*) may be used as correctives 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, *Qābiḍ* (astringent) [8, 9] and anthelmintic to the bowels. [6] It is indicated in classical literature for *Iltihāb al-Shu'ab* (bronchitis), *Rabw* (bronchial asthma), *Zaḥīr* (dysentery), *Najis-i-Dam* (blood impurities) and *Qurūḥ* (ulcers). [6]

Seed: The seeds are known as good *Qābiḍ* (astringent) to the bowels, [6] *Muḥallil-i- Awrām* (anti-inflammatory), anti-arthritic, *Dafi'-i-Ḥummā* (antipyretic) and *Musakkin-i-Alam* (analgesic). [11]It is indicated as *Dafi'-i-Dhayābīṭus* (antidiabetic agents) in *Dhayābīṭus Ḥārr* (diabetes mellitus). [6] It diminishes the quantity of sugar in urine and allays the unquenchable thirst of diabetes. [8] The seed is also used in *Ḍu'f al-Mi'da* (weakness of stomach), *Ḍu'f al-Jigar* (weakness of liver), *Musakkin-i-Sozish* and *Ishāl-i-Damwī* wa *Ṣafrāwī* (haemorrhagic and bilious diarrhoea). [17]

Leaves: Its leaves are also used as *Qābiḍ* (astringents) in *Zaḥīr* (dysentery) [6] and *Muḥallil-i- Awrām* (anti-inflammatory) in *Qulā*'(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-Litha* (teeth and gums) and act as *Qābiḍ* (astringent) in *Is'hāl-i- Ṣafrāwī* (bilious diarrhoea). They are also used in sore throat and ringworm in the head. [6] The vinegar made of the fruit is tonic, *Muqawwī-i-Mi'da* (stomachic), *Qābiḍ* (astringents) and *kāsir-i-Riyāḥ* (carminative). [6, 8] It is useful in diseases of the spleen. [8] It is also used as a *Mudirr-i-Bawl* (diuretic) and *Dafi'-i-Dhayābīṭus* (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-e- Damwī* (Haemorrhagic diarrhoea) [9,12,13,17,18,21,23,24]

3. *Is'hāl-i- Ṣafrāwī* (Bilious diarrhoea)[2,9,12,13,17,18,21,24,26]
4. *Ḍu'f al-Mi'da* (Weakness of stomach) [2,18,21,23]
5. *Warm-e- Ṭiḥāl* (Splenitis) [18,23]
6. *Dhayābīṭus Ḥārr* (Diabetes mellitus)[9,11,12,18,21,25,26]
7. *Qulā'* (Oral ulcer / Stomatitis) [13,24,26]
8. *Ḥummā* (Fever)[6,8,13,24]
9. *Bawl Zulālī* (Albuminuria) [25]
10. *Tasaddud Shaḥmī Kilsī* (Atherosclerosis)[25]
11. Bacteriuria[25]
12. *Hasāt-i-Mathāna* (Bladder Stone)[25]
13. *Sarṭān* (Cancer) [25]
14. Cholecystosis[13,24,25]
15. *Waram -al-Mathāna* (Cystitis)[25]
16. *Usr al-Bawl* (Dysuria)[25]
17. *Ūdhīmā* (Oedema) [25]
18. Gallstone[25]
19. *Niqris* (Gout)[25]
20. *Bawl al-Dam* (Haematuria)[25]
21. *Waram* (Inflammation)[12,13,25]
22. *Hasāt-i-* Kulya (Kidney Stone)[25]
23. Low Blood Pressure [25]
24. *Waram al-Kulya* (Nephritis)[25]
25. *Ḥudār* (Rheumatism)[25]
26. *Sujan* (Swelling)[25]
27. *Bandīsh-i- Idrār* (Water/Urine Retention)[25]
28. *Uqr* (Infertility)[11]
29. *Ḍu'f al-Ishtihā'*(Loss of appetite)[13,18,21,24]
30. *Ḥassāsiyat* (Allergy)[18]
31. *Qāṭi'-i-Bāh* (Anaphrodisiac) [13,23,24]
32. *Ḍu'f al litha*(Weakness of gums)[17]
33. *Dā'al-Tha'lab* (Alopecia Areata)[6,13,24]
34. Sore throat[6,13,24]
35. *Iltihāb al-Shu'ab* (Bronchitis) [6,13,24]
36. *Rabw* (Bronchial Asthma) [6,13,24]
37. *Najis-i-Dam* (Blood Impurities)[13,24]
38. 'Uṭāsh Mufriṭ (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 has been described as follows.

1. *Dafi'-i-Ḥummā* (Antipyretic)[13,18,21,24]
2. *Qābiḍ* (Astringent)[2,6,8,9,13,18,21,22,24,25]
3. *Kāsir-i-Riyāḥ* (Carminative)[2,6,8,12,13,24,25]
4. *Mushtahī* (Appetizer)[13,18,21,24]
5. *Muḥallil-i- Awrām* (Anti-inflammatory)[25]
6. *Qaat-i-Ṣafrā* (Anti-bilious)[6,9,13,22,24]
7. *Dafi'-i-Dhayābīṭus* (Antidiabetic) [2,6,8,9,11,12,13,14,24,25,26]
8. *Muqawwī-i-Jigar* (Hepatotonic)[11,13,18,21,23,24]
9. *Dafi'-i-Jarāsīm* (Antibacterial)[11,12,25]
10. *Dafi'-i-Fīṭar* (Anti-fungal activity)[2,11,25]
11. *Muḥāfiẓ-i- Qalb* (Cardio-protective effects)[18]
12. *Dafi'-i-Is'hāl* (Anti-diarrheal effects)[12,17,26]
13. *Dafi'-i-Ḥassāsiyat* (Anti-allergic effects)[22]
14. *Musakkin-i-Alam* (Analgesic)[25]
15. *Tiryāq* (Antidote) for nux-vomica[25]
16. *Dafi'-i-Tahabbujī* (Antiedemic)[25]
17. *Dafi'-i-'Ufunat* (Antiseptic)[25]
18. *Dafi'-i-Tashannuj* (Antispasmodic)[25]
19. *Quwwat-i-Bāh* (Aphrodisiac)[23,25]
20. *Muqawwī-i-Mi'da* (Stomachic) [2,8,9,12,13,17,18,21,22,23,24]
21. *Mudirr-i-Bawl* (Diuretic)[2,6,8,9,12,25]
22. *Uqr* (Sterility)[11]
23. *Muṣaffī-i-Dam* (Blood Purifier)[13,22,24]
24. *Muqawwiyāt-i-Asnān-o-Litha* (Strengthen the gums and teeth)[13,24]
25. *Khafaqān* (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%),[3,12] ellagic acid,[3,12] gallic acid (1-2%),[3,12] glycoside (jamboiine), starch and small quantity (0.05%) of a pale-yellow essential oils[3,12], chlorophyll, fat, resin, albumin,[8] hexahydroxydiphenoyl glucose and its isomer hexahydroxydiphenic acid, 1-galloylglucose[27] and elements such as zinc, chromium, vanadium, potassium and sodium.[14]

Fruit: It contains anthocyanins, citric, malic and gallic acids, glucose and fructose [12], and oxalic acid. [3] It is reported that the colour of the fruits might be due to the presence of anthocyanins namely delphinidin-3-gentiobioside and malvidin-3- laminaribioside along with petunidin-3-gentiobiosid. [14]

Leave: Aliphatic alcohols, sitosterol, betulinic acid, crategolic acid [12], Quercetin (0.0085%), myricetin (0.023%), myricitrin (0.009) and myricetin 3-O-4"-acetyl. - α -L-rhamnopyranoside (0.059%) are found in it. [28]

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

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 has hypoglycaemic activity. [29]

2. Anti-inflammatory activity: Muruganandan 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 Mahaptra et al reported that seed extract of *S. cuminii* had anti-inflammatory 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 Ethanolic 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 (CCL_4).[37]

8. Anti-Cancer Activity: For *Sarṭān* (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).[38] 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) amazonensis. 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 amazonensis 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 intracellular amastigotes, respectively) than ScEO (IC50 values of 43.9 and 38.1 µg/mL against axenic and intracellular amastigotes, respectively).[40] This report suggests that it may be used in prevention and treatment of Leishmaniasis.

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

11. Antianaemic activity: It has been reported that aqueous seeds extract of *S. cumini* possessed antianaemic activity. In a study it revealed that seed extract of the *S. cumini* increased total haemoglobin. [42]

12. Antibacterial activity: Bhuiyan et al in their study reported that methanol and ethyl acetate extracts of the seeds of *E. jambolana* at a concentration of 200 µg/disc showed antibacterial activity against *Bacillus creus, B. subtalis, B. megateriun, Steptococcus ß–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 oleanolic acid isolated from the flowers of *E. jambolana*. It decreased the fertilizing 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 spermatides and arrest of spermatogenesis at the early stages of meiosis leading to decrease in sperm count without any abnormality to spermatogenic cells, leyding 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: Adikay et al. studied the nephroprotector 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 nephroprotector 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 ethanol 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 extract 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 (kernel), leaves and bark possesses medicinal values. It is commonly used as anti-diarrhoeal, digestive, astringent and antibacterial drug. In classical literature, it is indicated for *Ḍu'f al-Mi'da* (weakness of stomach), *Ishāl-e- Damwī* (haemorrhagic diarrhoea), *Is'hāl-i-Ṣafrāwī* (bilious diarrhoea) and *Dhayābīṭus Ḥārr* (diabetes mellitus). In several experimental studies, it has been reported that it possesses *Dafi'-i-Dhayābīṭus* (antidiabetic), *Muḥallil-i- Awrām* (anti-inflammatory), *Dafi'-i-Jarāsīm* (antibacterial) and *Dafi'-i-Ḥummā* (antipyretic) 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 *Dafi'-i-Dhayābīṭus* (antidiabetic), *Muḥallil-i- Awrām* (anti-inflammatory), *Dafi'-i-Jarāsīm* (antibacterial) and *Dafi'-i-Ḥummā* (antipyretic) potential. In 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.

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References:

1. Noomrio MH, Umar Dahot M: Nutritive value of Eugenia jambosa fruit. Med J Isla Acad Sci 1996; 9:9–12.
2. Dymock, W.et.al. "*Pharmacographia Indica*" A history of the principal drugs of vegetable origin; Vol-2; 1890: 24-26.
3. Anonymous. Wealth of India. A Dictionary of Indian Raw materials and Industrial Products, National Institute of Science Communication, Council of Scientific and Industrial Research. New Delhi, Vol.10:Pp. 100-104. 2014.
4. V. M. Jadhav et al, Herbal medicine: *Syzygium cumini*: A Review, Journal of Pharmacy Research 2009, 2(8), 1212-1219.
5. Veeram Anjali et al, A review on pharmacology and phytochemistry of Syzygium cumini; Indian J. Pharm. Biol. Res., 2017; 5(4):24-28.
6. Kirtikar, K.R. & Basu, B.D. (1987) Indian Medicinal Plants, International Book distributors Dehradun, Vol. I, PP. II 1052-1054. 1999.
7. Anonymous. Qarabadeen Sarkari. ed. 2nd. New Delhi: CCRUM; 2006: Pp.49.
8. Nadkarni, K.M. Indian Materia Medica, Vol. I, 3rd edition, 1976, Bombay Popular Parkashan, PP. 516-18.
9. Chopra, R.N., Nayar, S.L. & Chopra, I.C., Glossary of Indian Medicinal Plants, 1st ed, 1956, Council of Scientific and industrial research, New Delhi, PP. 238.
10. Gupta A K, Tendon N, Sharma M. Quality standard of Indian medicinal plants. New Delhi.ICMR 2008.vol.7.Pp.295.
11. Pullaiah T. Encyclopaedia of World Medicinal Plants: New Delhi: Vol.4th .Regency Publication; 2006. Pp.1892.
12. Khare CP. Indian Medicinal Plants: 1st ed. New Delhi: Springer Science; 2007. Pp .639.
13. Khān M A, Muḥīṭ-i-A'zam, 2013; Vol.II, CCRUM, New Delhi.Pp.132-134.
14. Usman M R M, Choubey N. Journal of Pharmacy Research Vol.11 Issue 2 February 2017: Pp. 83-90.
15. Nair K N. The Genus Syzygium Syzygium cumini and Other Underutilize Species, CRC Press Taylor & Francis Group: 2017. PP: 57-58.
16. Nair k N. The Genus Syzygium Syzygium cumini and Other Underutilize Species, CRC Press Taylor & Francis Group: 2017. PP: 60-61.
17. Anonymous. The Unani Pharmacopeia of India: Vol. IV Part-1 New Delhi: Ministry of Health and Family Welfare; 2007. 55-57.
18. Tarique NA. Taj –al – Mufradat: 1st ed. New Delhi: Idara Kitab-al –Shifa; 2010. Pp.262.
19. Pradhan M et al. Phytochemistry, Pharmacology and Novel Delivery Applications of Syzygium cumini (L.). International journal of pharmacy and Pharmaceutical research. 2016; Vol. 7 (1): 659-675.
20. Kumawat M, Damor J, Kachchhwaha J, Garg A K, Singh C. Pharmacological Properties and Therapeutic Potential of *Syzygium cumini* (JAMUN): A REVIEW. World Journal of Pharmaceutical Research, Volume 7, Issue 03, 312-322. 2018.
21. Kabeeruddin M. Makhzanul Mufradat Al- Maroof Khawasul Advia: Deoband: Faisal Publication; 2000.Pp. 215-16.
22. Bahadur M. Mufradat-i- Maseehahi (Translated by Khan J A, Nikhat S), Deoband.2012, Masood Publishing House. Pp. 39.
23. Nabi GN. Makhzan- i-Mufradat –wa- Murakkabat. New Delhi: CCRUM; 2007. Pp.103.
24. Ghani NM. Khazainul Advia: Vol.2 Lahore (Pakistan): Idara Matbuat-i- Sulemani.1998. Pp.240-241.
25. Duke JA, Godwin MJB, Cellier J D, Peggy-Ann K. Duke Handbook of Medicinal Herbs: 2nd ed. London: CRC Press; 2002: Pp. 422.
26. Bhattacharya S K. Hand Book of Medicinal Plants. Jaipur, Pointer Publication. 5th ed. 2008. Pp. 338.
27. Bhatia IS, Bajaj KL. Tannins in Black-Plum (Syzygium cumini L.). Biochem J 1972; 128(1):56-57.
28. Timbola AK, Szpoganicz B, Branco A, Monache FD, Pizzolatti MG. A new flavonol from leaves of Eugenia jambolana. Fitoterapia 2002; 73:174-76.
29. Pandey M, Khan A. Hypoglycaemic effect of defatted seeds and water soluble fibre from the seeds of Syzygium cumini (Linn.)

skeels in alloxan diabetic rats. Indian journal of experimental biology. 2002; 40(10):1178-1182.
30. Muruganandan S, Srinivasan K, Chandra S, Tandan S K, Lal J, Raviprakash V. (). Anti-inflammatory activity of Syzygium cumini bark, Fitoterapia, 2001; 72(4): 369-375.
31. Herculano ED, da Costa C, Rodriques AK, Araújo-Júnior JX, Santana EG, França PH, Gomes ED, Salvador MJ, Moura FD, Ribeiro ÊA. Evaluation of cardiovascular effects of edible fruits of Syzygium cumini Myrtaceae (L) skeels in rats. Tropical Journal of Pharmaceutical Research. 2014; 13(11):1853-61.
32. Priya, S. S. L., P. R. Devi, and A. Madeswaran., In silico docking studies of RP2 (X-linked retinitis pigmentosa) protein using anthocyanins as potential inhibitors, Bangladesh J. Pharmacol, 2013; 8: 292–299.
33. Mahapatra PK, Chakraborty D, Chaudhuri AN, Anti-inflammatory and antipyretic activities of Syzygium cuminii, Planta medica. 1986 Dec; 52(06):540.
34. Chaudhuri AK, Pal S, Gomes A, Bhattacharya S, Anti-inflammatory and related actions of Syzygium cuminii seed extract, Phytotherapy Research, 1990 Feb 1; 4(1):5-10.
35. Mukherjee P.K., Saha K., Murugesan T., Pal M, Saha B.P. (1998). Screening for antidiarrhoeal profile some plant extract of specific region of West Bengal, India. Journal of Ethnopharmacology, 60(1), 85-89.
36. Das S, Sarma G. Study Of The Hepatoprotective Activity Of The Ethanolic Extract Of The Pulp Of Eugenia Jambolana (Jamun) In Albino Rats. Journal of Clinical and Diagnostic Research. 2009April ;(3)1466-1474.
37. S.S. Sisodia, M. Bhatnagar. Hepatoprotective activity of Eugenia jambolana Lam. in carbon tetrachloride treated rats: Indian J Pharmacol. Feb 2009; 41(1): 23-27.
38. Scalbert, A, Williamson, G, Dietary intake and bioavailability of polyphenols, J. Nutr, 2000; 130: 2073S–2085S.
39. Mittal AK, Bhaumik J, Kumar S, Banerjee UC, Biosynthesis of silver nanoparticles: Elucidation of prospective mechanism and therapeutic potential, J Colloid Interface Sci, 2014; 415:39-47.
40. Rodrigues KA, Amorim LV, Dias CN, Moraes DF, Carneiro SM, Syzygium cumini (L.) Skeels essential oil and its major constituent α-pinene exhibit anti-Leishmania activity through immunomodulation in vitro, J Ethnopharmacol, 2015 3; 160:32-40.
41. Ravi K, Rajasekaran S, Subramanian S, Antihyperlipidemic effect of Eugenia jambolana seed kernel on streptozotocin-induced diabetes in rats, Food and Chemical Toxicology, 2005 Sep 30; 43(9):1433-9.
42. Prince PS, Menon VP, Pari L, Hypoglycaemic activity of Syzigium cumini seeds: effect on lipid peroxidation in alloxan diabetic rats, Journal of Ethno pharmacology, 1998 May 31; 61(1):1-7.
43. Singh A, Navneet, Ethnobotanical uses, Antimicrobial potential, Pharmacological Properties and Phytochemistry of Syzygium cumini Linn syn. Eugenia Jambolana (jamun) – A REVIEW, International Journal of Innovative Pharmaceutical Sciences and Research, 2018; 6 (01):32-47.
44. Rajasekaran M, Bapna JS, Lakshmanan S, Nair AR, Veliath AJ, Panchanadam M, Antifertility effect in male rats of oleanolic acid, a triterpene from Eugenia jambolana flowers, Journal of ethno pharmacology, 1988 Sep 1; 24(1):115-21.
45. Kumar A, N. Padmanabhan, M. R. V. Krishnan, Central nervous system activity of Syzygium cumini seed, Pak. J. Nutr 2007; 6: 698–700.
46. Adikay S, P. Belide, B. Koganti, Protective effect of fruits of Syzygium cumini against Cisplatin-induced acute renal failure in rats, J. Pharm. Res, 2010; 3: 2756–2758.
47. Jagetia, G. C., M. S. Baliga, Syzygium cumini (jamun) reduces the radiationinduced DNA damage in the cultured human peripheral blood lymphocytes, A preliminary study, Toxicol. Lett, 2002; 132: 19–25.
48. Arun, R., M. V. Prakash, S. K. Abraham, and K. Premkumar. 2011. Role of Syzygium cumini seed extract in the chemoprevention of in vivo genomic damage and oxidative stress. J. Ethnopharmacol. 134: 329–333.
49. Mastan S. K., A. Saraseeruha, V. Gourishankar, G. Chaitanya, N. Raghunandan, G. A. Reddy, K. E. Kumar, Immunomodulatory activity of methanolic extract of Syzygium cumini seeds, Pharmacologyonline, 2008;3: 895–903.
50. Zhi-Ping, R., Z. Liang-Liang, and L. Yi-Ming, Evaluation of the antioxidant activity of Syzygium cumini leaves, Molecules 2008; 13: 2545–2556.