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Phytopharmaceutical Benefits of *Syzygium cumini*: Insights from the Indian Traditional Medicine

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ABSTRACT

Syzygium cumini, popularly known as Indian blackberry is a versatile traditional medicinal plant, belongs to the family: Myrtaceae and documented for various folklore claims. It is native to South Asia, and has also been referenced in Ayurveda, Siddha, Unani and still used for therapeutic benefits. In Ayurveda, it is pronounced as *jambul* or *jamun* and represented as highly valued because of its ability to manage conditions like diabetes, digestive disorders, and general debility. The phytochemical investigations of *S. cumini* reveals the presence of various bioactive compounds such as flavonoids, alkaloids, tannins, phenolic acids, and essential oils. The antioxidant potential of *S. cumini* beneficial for various ailments is attributed to the scavenging of free radicals' property, while chemotherapeutic potential of this plant is linked to the inhibition of pathogenic microorganisms. Almost majority of *Syzygium cumini* plant parts are investigated but the seeds still need more exploration to confer the folklore use of seed exhibiting significant antidiabetic effects probably by modulating glucose metabolism and enhancing insulin sensitivity, the anti-inflammatory and antihyperlipidemic activities are attributed to the inhibition of pro-inflammatory mediators and regulation of lipid metabolism, respectively. Overall, the diverse biological activities of *S. cumini* seed underscore their potential therapeutic applications in the management of various ailments, including diabetes, microbial infections, inflammation, hyperlipidemia, and cancer. Further research is warranted to elucidate the underlying mechanisms of action and optimize their utilization in biotechnological, pharmaceutical and nutraceutical formulations.

Keywords- *Syzygium cumini*, Folklore, Diabetes, Antihyperlipidemic, Anti-inflammatory, Medico-pharmaceutical, Nutraceutical

Introduction

The prominent Indian medical systems include Ayurveda, Siddha, and Unani, all of which incorporate herbs and minerals in their formulations. India boasts a rich heritage of traditional medicinal plant base systems supported by its vast biodiversity, and reports about 15,000 species with varying medicinal properties, with 15 agro-climatic zones and 47,000 plant species, found to be essential for herbal treatments. The World Health Organization has also advocated for evaluating the effectiveness of plants, especially in cases where safe synthetic drugs are unavailable or to alleviate chronic drug usage issues.[1]*Syzygium cumini (L.)* is one of the well-

recognized and traditionally used in various culture of India, documented in *Chark Sanhita*, which is also known as *Eugenia jambolana* Lam. and *Syzygium jambolanum*. *S. cumini* is a large evergreen tree reaching up to 30 meters in height with a girth of 3.6 meters and a bole up to 15 meters. This species is widespread throughout India and can grow at altitudes up to 1,800 meters[3]. Various parts of the *S. cumini* tree are utilized in traditional medicinal systems in India and China.The leaves of *S. cumini*are leathery, oblong-ovate to elliptical or obovate, measuring 6-12 cm in length, with broad and shortly pointed tips. The panicles, which are 4-6 cm long, typically emerge from the branchlets below the leaves, and can be axillary or terminal. The flowers are numerous, fragrant, pink or nearly white, and grow in crowded fascicles at the ends of the branchlets. The calyx is funnel-shaped, about 4 mm long with four teeth, while the petals are fused and fall as a small disk. The numerous stamens are as long as the calyx.

The fruit is oval to elliptic, 1.5-3.5 cm long, dark purple or nearly black, luscious, fleshy, and edible, containing a single large seed[2-3] (Fig. 1 – a, b and c). It features glossy, dark green leaves and small, fragrant white flowers. However, it is the purplish-black, plum-like fruits that stand out, celebrated for their sweet and tangy flavor as well as their nutritional richness. The fruits are widely consumed for their culinary delight and health benefits, recent attention has focused on the therapeutic potential of *S. cumini* seeds. These small, dark brown seeds possess a complex phytochemical profile, including flavonoids, phenolic compounds, tannins, alkaloids, and essential oils. These bioactive constituents contribute to their potential health-promoting effects

Fig.1 a) *SYZYGIUM CUMINI* TREE b) MATURE FRUITS ON TREE c)DRIED SEEDS OF FRUITS

Ethnomedicinal properties:

In traditional medical systems, various parts of the *Syzygium cumini*, particularly seeds, have been utilized to address a variety of ailments, including digestive disorders, diabetes, and dermatological conditions. Recent scientific investigations have substantiated many of these traditional uses, revealing the pharmacological properties and underlying mechanisms of action that contribute to the therapeutic benefits of *Syzygium cumini* seeds .*Syzygium cumini* has garnered attention from researchers and herbalists due to its diverse properties associated with major plant parts:

1. **Fruits:** Jamun fruits have antioxidants and anti-inflammatory effects. They are suitable for managing blood sugar due to their low glycemic index.
2. **Leaves:** Used traditionally for antidiabetic purposes, the leaves contain tannins, alkaloids, and flavonoids.
3. **Bark:** The bark has antimicrobial properties and is used in Ayurvedic medicine for astringency and antidiarrheal effects
4. **Seeds:** Alkaloids, glycosides, and saponins are found in the seeds. Researchers have explored their potential antihyperlipidemic and antihyperglycemic effects.

The increasing interest in natural products for therapeutic purposes is driven by the rising prevalence of chronic diseases and the limitations of conventional treatments. *Syzygium cumini* seeds, noted for their rich array of bioactive compounds, offer promising potential for drug discovery and development. These seeds possess diverse pharmacological properties, including antioxidant, anti-inflammatory, and antidiabetic activities. Modern research has increasingly corroborated the traditional uses of *Syzygium cumini* seeds, highlighting their significant potential in managing various health conditions. The bioactive compounds in these seeds are

being explored for their ability to contribute to the development of novel therapeutic agents, addressing the need for more effective and safer treatments for chronic diseases

Scientific Classification:[2]

Syzygium cumini belongs to the kingdom Plantae, indicating that it is a plant. It falls within the phylum Magnoliophyta, which includes all flowering plants, and the class Magnoliopsida, denoting that it is a dicotyledonous plant.It is further classified under the subclass Rosidae. The order Myrtales places it among other plants with similar floral structures. It belongs to the family Myrtaceae, commonly known as the myrtle family. Within this family, it is part of the genus Syzygium, and its species designation is cumini (L.) Skeels

Ayurvedic Properties:[3-5]

- **Rasa(Kasaya, Madhura, Amla):**The taste Kasaya (astringent), Madhura (sweet), and Amla (sour) play significant roles in balancing the doshas. Kasaya Rasa, characterized by its dry and cool nature, helps to manage the body's moisture and firmness. Madhura Rasa, known for its nourishing and soothing qualities, provides strength and balances the body’s internal harmony. Amla Rasa, with its sour taste, stimulates digestion and supports metabolic processes
- **Virya (Sita):**The Virya, or potency, of these tastes is classified as Sita (cool), indicating that they have a cooling effect on the body. This is important for balancing excessive heat and calming inflammation.
- **Guna (Laghu, Ruksa):** Guna (qualities) associated with the taste are Laghu (light) and Ruksa (dry), which influence how they affect bodily tissues and functions. Laghu promotes lightness and ease of movement, while Ruksa helps in reducing excess moisture.

- **Vipaka (Madhura, Katu):** Vipaka, the post-digestive effect of the tastes, for these substances is Madhura (sweet) and Katu (pungent). Madhura Vipaka helps in nourishing and balancing Vata and Pitta doshas, while KatuVipaka aids in reducing Kapha dosha. These effects are critical for maintaining overall doshic balance and promoting health.
- **Karma (Vatala, Pittahara, Kaphahara, Vistambhi, Grahi):**these tastes and qualities have multiple therapeutic effects. They are Vatala (balancing Vata), Pittahara (alleviating Pitta), and Kaphahara (reducing Kapha). Additionally, they exhibit Vistambhi (obstructive) and Grahi (absorbent) properties, which can be utilized to manage various health conditions by promoting or restricting bodily functions as needed.

जाम्बूसुर्भिपत्राचराज्जम्बुमर्◌िफलासुर्भिस्यार्न्मर्◌ाजाम्बुमर्◌िस्कन्धप्रकृ ति◌ि◌ाि।

Surbhipatra, rajajambu, mahaphala, surbhi all are synonyms of Syzygiumcumini.

जाम्बवंवा◌िलंप्राहस्र्वाद्वम्लंकफपपत्तजजि।◌्

हृत्कण्डकषणंचान्यिक्षायंक्षुद्रजाम्बवम॥◌्

Jamun is sweet and sour in taste, aggravates vata dosha and it is styptic and used to pacify kapha and pitta dosha.

Table 1:Vernacular namesof *S.cumini* (Jamun)[5]

Languages	**Vernacular Name**
Sanskrit	Mahajambu, Ksudrajambu
Hindi	Jamun, Jambol, Jambul
English	Java plum, Black plum
Assam	Jam

Bengali	Kalajam
Telegu	Neredu, Chettu
Tamil	Saval naval
Malayalam	Naval
Kannada	Nerale
Punjabi	Jamalu

Origin And Distribution:

Syzygium cumini, originally native to India and the East Indies, is distributed across various regions. It occurs naturally in countries like Thailand, the Philippines, and Madagascar. Additionally, successful introductions have led to its presence in other tropical areas, including the West Indies, East and West Africa, and certain subtropical regions such as Florida, California, Algeria, and Israel[6].

Description of seed

- **Macroscopic characteristics:** The seeds exhibit a cream-colored, coriaceous covering that is smooth and either oval or roundish. Within each fruit, there is either a single seed measuring 1 to 2 cm in length or a cluster of 2 to 5 seeds tightly compressed, resembling a single seed. The entire seed structure is enclosed by a cream-colored, coriaceous covering with an oval or round shape.
- **Microscopic characteristics[3]:** Cotyledons are characterized by an outer layer made up of a single layer of epidermal cells. The mesophyll, located beneath this epidermis, is composed of isodiametric, thin-walled parenchyma cells. These parenchymatous cells are densely packed with simple starch grains, which are oval to rounded in shape and

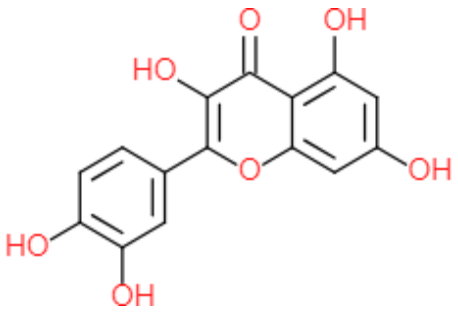
measure between 7 and 28 micrometers in diameter. Additionally, a few schizogenous cavities, which are intercellular spaces formed by the separation of cell walls, can also be found within the cotyledons.

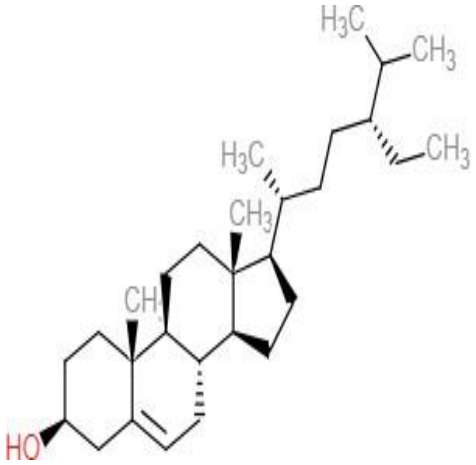
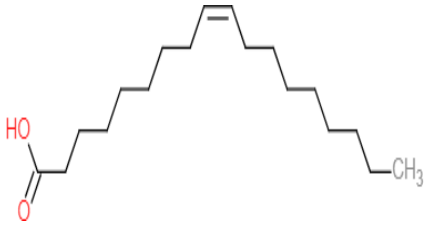
- **Powder characteristic of seed[5]:** The powder is brown in color and contains a limited number of parenchymatous cells. It is also abundant with oval-shaped starch grains, which vary in size, measuring between 7 and 28 micrometers in diameter.

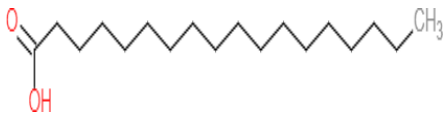
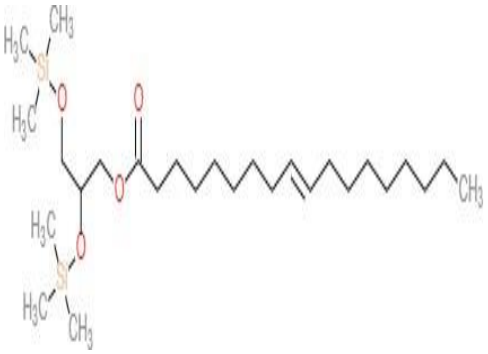
Phytochemistry

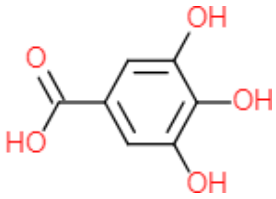
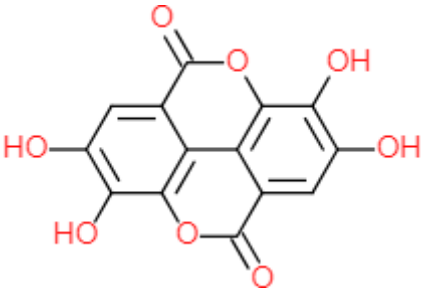
The major phytoconstituent with bioactive compounds and structure reported are tabulated in the Table 2. [7, 8, 9, 10, 48]

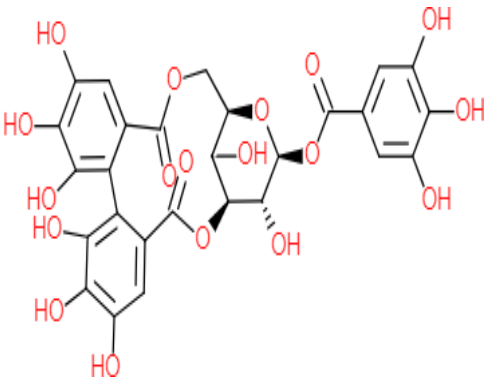
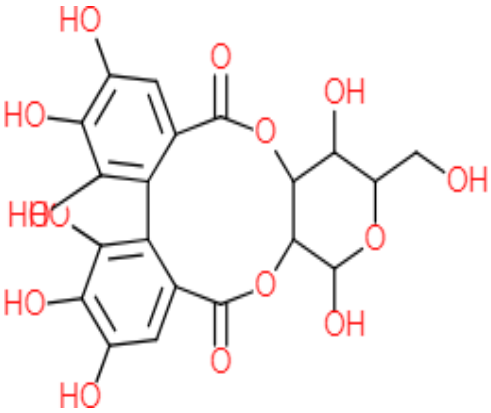
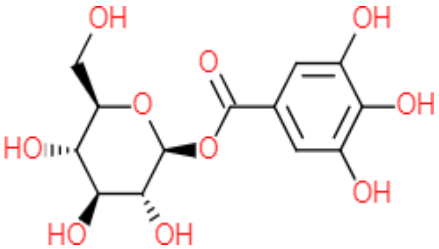
Table 2: Major Phytoconstituents of *S. cumini* seeds

Phytoconstituent	Bioactive compounds	Structure
Flavonoids	**Quercetin**	

Phytosterols	**β-sitosterol**	
Fatty acids	**Oleic acid**	
	Stearic acid	

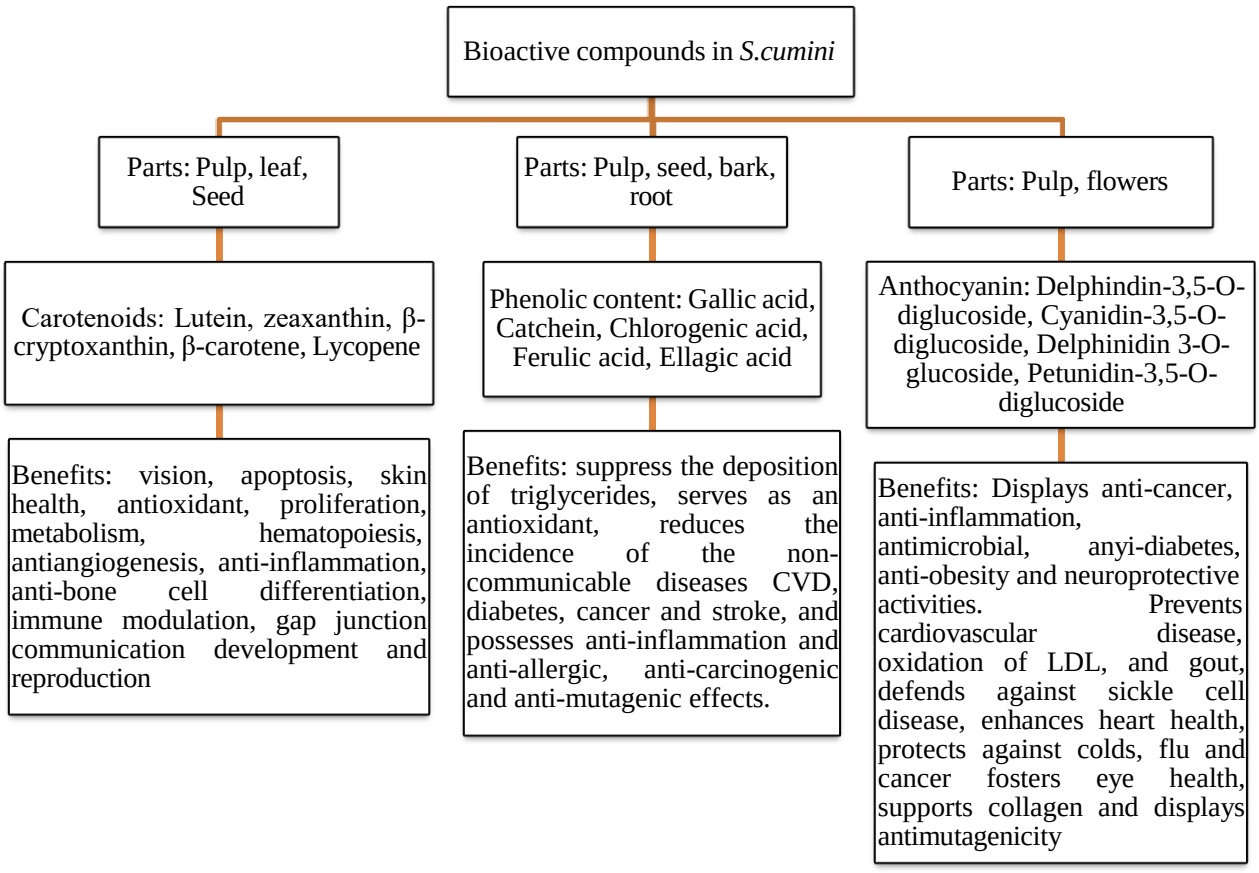
		
	1-monolinoleoylglycerol trimethylsilyl ether	

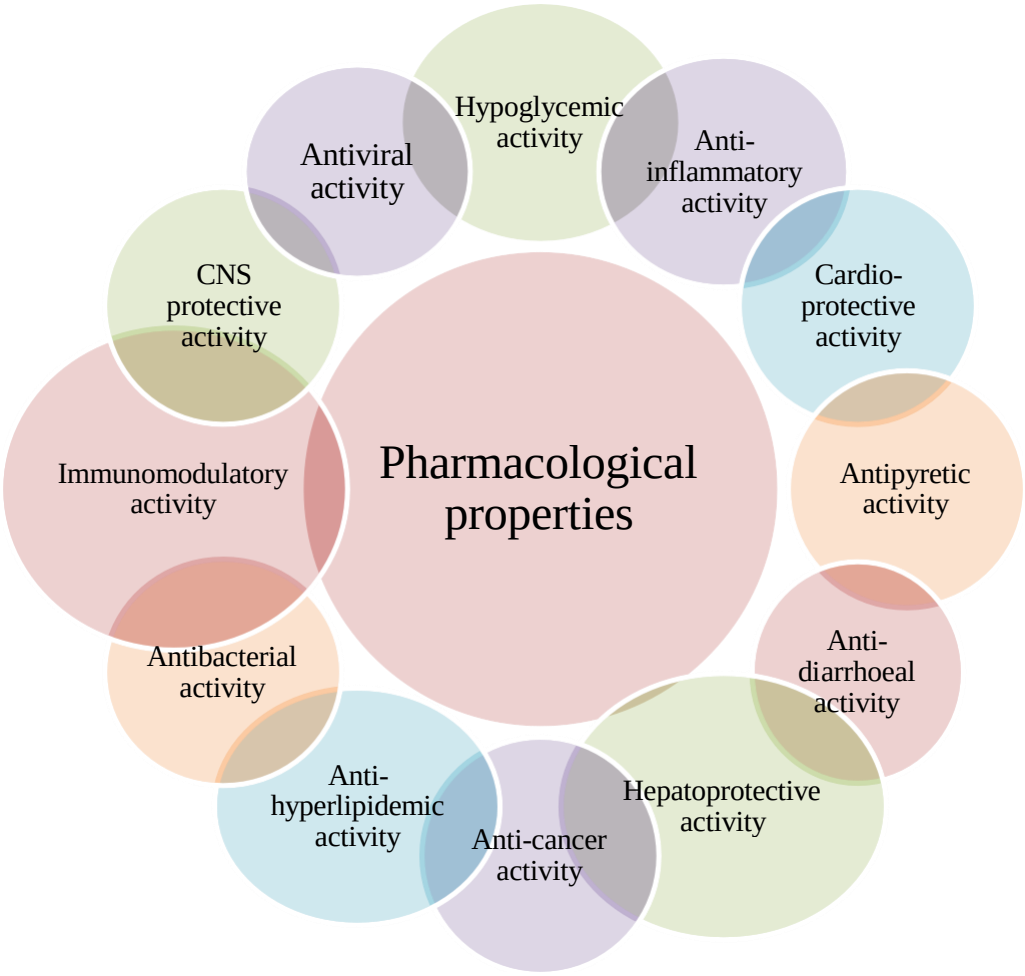
	n-hexadecanoic acid	
Phenolic acids	**Gallic acid**	
	Ellagic acid	

Tannins	**Corilagin**	
	3,6-hexahydroxy diphenoylglucose	
	1-galloylglucose	

Other bioactive compounds are: 2-bromo-cyclohexasiloxane, dodecamethyl, cycloheptasiloxane, tetradecamethyl, pyrazole[4,5-b] imidazole, 1-formyl-3-ethyl-6-beta-d-ribofuranosyl,3-(octadecyloxy) propyl ester, benzaldehyde

Fig.2: Major bioactive compounds in Jamun and their benefits[10]





Medico-pharmaceutical applications:

Fig. 3: Pharmacological and clinical applications of *S. cumini*seeds

1. Anti-inflammatory activity:[11]

The anti-inflammatory efficacy of an ethanolic extract of *S.cumini* bark was reported by Muruganandan et.al. Mice at doses ranging from 10–125 µg/kg.i.p. showed neither signs of toxicityto extract, nor irritating the signs of the stomach mucosa. This research proved that *S. cumini* bark extract effectively reduced inflammation throughout all stages.

2. Antiviral activity:

The CPE reduction assay was used to determine thevirucidal, pre- and post-exposure potential of cold and hot water extracts of SC's bark and leavesagainst H5N1, an exceedingly infectious avian influenza virus. In both the virus yield reductionexperiment and the egg-based assay, it was reported that the viral load was suppressedby the hot and cold aqueous bark and leaf extracts, respectively. The H5N1 virus wassuccessfully inhibited by both the cold (43.5 CC50/EC50, or select index) and hot (248 EC50) water extracts of the bark. Both the goat, oxand buffalo pox viruses were also reported to be inhibited by the water-based leaf extract.[11]

3. Gastroprotective Activity:[12]

Rats with stomach ulcers induced by aspirin, pylorus ligation, ethanol, or 2-hour cold restraintstress were investigated by Chaturvedi et al. The ethanolic extract from the seeds of *E. jambolana* produced protective effects against the induced ulcers, the result of its actions on offensive and defensive elements simultaneously. *Eugenia jambolana*'s antioxidant qualities were claimed asareason for its efficacy.

4. CNS activity:[13]

The *Syzygiumcumini* Linn seed extracts, fractions, and subfractions were investigated for their sedative and anticonvulsant effects by the De Lima et al. on mice. Thehydroalcoholic extract was found to have a hypothermic impact andalso showed anticonvulsant effects inpentylenetetrazol and maximal electroshock convulsions experimental models. Subfractions ofethyl acetate increased the latency and duration of pentylenetetrazol's model. Such effects indicate that some of theactive components in *S. cumini* have anticonvulsant potential, in addition to central depressive effects.

5. Antiallergic activity:[14-15-16]

In the allergic pleurisy model studied by Britto et al., the inhibition of eosinophil accumulation was likely caused by an impairment of CCL11/eotaxin and IL-5 production, while the edematogenic effect of *S. cumini* stems was believed to be caused by the inhibition of mast cell degranulation and may also by affecting the histaminergic and serotonergic pathways.When histamine-induced pedal edema was studied by the Mahapatra et al, the methanol extract of dried seeds was claimed as antihistaminergic.

6. Antipyretic activity:[15-16]

Mahapatra et al. demonstrated that rats administered with 50 mg per kg of methanol extracts of dried seeds were able to prevent yeast-induced pyrexia. Similarly, Chaudhari et al. also reportedthat chloroform extracts of dried seeds have potential to lower the elevated body temperature among animal models.

7. Antihyperlipidemic:[17]

In about 40% of people with diabetes mellitus, abnormal lipid profiles manifestation is one of the disease's most common complications. Kasiappan et al. showed that in streptozotocin-induced rats administration of ethanolic extract of *E. jambolana* kernelby oral route with a dose of 100 mg/kg body weight, produced antihyperlipidemic activity, and authors recommended it as the gold standard for treating hyperlipidemia.

8. Antispasmodic activity:[18-19]

A pilot study by Dhawan et al. indicated that an ethanol-water (1:1) extract of the aerial sections of *S. cumini*had no effect on the guinea pig ileum spasms with respect to acetyl choline

andhistamine.While Mokkhasmit et al. determined that guinea pig ileum was actively affected by ethanol water (1:1) dry bark extract when dosed with 0.01 gm per ml.

9. Anti-diarrheal[20]

For conditions like diarrhea, natural products are often the preferred treatment. An oral administration of an ethanolic extract of *Syzygiumcumini* at a dose of 400 mg/kg has demonstrated a decrease in gastrointestinal activity in rat models. This effect was observed in cases of PGE2-induced enter pooling and castor oil-induced diarrhea.

10. Anti-fertility[21]

Oleanolic acid, a phytochemical extracted from the flowers of *Syzygiumcumini*, has been shown to halt spermatogenesis, demonstrating anti-fertility effects in male albino rats.

11. Antinociceptive[22-23]

The hydro-alcoholic leaf extract of *Syzygiumcumini* was evaluated for its analgesic potential in rats. Cutaneous nociception was assessed using the hot plate and formalin tests, while muscular nociception was evaluated by measuring forelimb grip force. At doses ranging from 100 to 300 mg/kg administered intraperitoneally, the extract significantly reduced pain scores across all phases of the formalin test. However, even at the highest dose of 300 mg/kg, the extract did not alter grip force in intact rats. These findings indicate that the extract possesses excellent analgesic activity, effective in alleviating both cutaneous and deep muscle pain.

In another study, methanolic extract of *S. cumini* fruits have been reported to have a significant central analgesic activity which wasinvestigated using the Eddy’s Hot Plate method.

12. Antilieshmanial[24]

Antileishmanial agents target and destroy protozoa of the genus Leishmania. The essential oil of *S.cumini*, particularly its main component α-pinene, has been evaluated for its antileishmanial activity against Leishmania amazonensis. α-Pinene demonstrated its efficacy as an antileishmanial agent at a dosage of 19.7 mg/ml. Additionally, its immunomodulatory action was considered a potential mechanism of action.

13. Diuretic[25]

The diuretic effect is recognized as a key therapeutic action for addressing various human ailments, including cardiovascular and liver diseases, kidney disorders, and cases of overdose or poisoning. Herbal remedies are often considered superior diuretics. In a study, petroleum ether, chloroform, methanolic, and aqueous extracts of *Syzygiumcumini* (Jaamun) bark were tested for their diuretic activity in Wistar albino rats at a dosage of 500 mg/kg body weight. The methanolic and aqueous extracts demonstrated significant diuretic activity, as evidenced by increased total urine output and elevated excretion of sodium and potassium electrolytes.

14. Hepatoprotective[26-29]

The alcoholic extract of *Syzygiumcumini* pulp, administered at 100 and 200 mg/kg/day, demonstrated significant hepatoprotective effects in albino rats with paracetamol-induced hepatotoxicity. This treatment resulted in a reduction of elevated serum levels of ALT, AST, and AP, and histopathological analyses showed a decrease in fibrosis and necrosis. Additionally, the anthocyanin-rich pulp extract (50 to 500 ppm) exhibited protective benefits against CCl4-induced liver damage by reducing lipid peroxidation, inhibiting LDH release, and increasing the activity of the antioxidant enzyme GPx. Both aqueous leaf extract and methanolic seed extract of

S. cumini have also been reported to offer hepatoprotective effects, supported by biochemical assays and histopathological studies.

15. Lipid peroxidation inhibition[30-32]

Some enzymatic and non-enzymatic reactions lead to lipid peroxidation, which is linked to mutagenesis and cellular damage. Extracts from the fruit pulp, seed coat, and kernel of *S. cumini* were evaluated for their ability to inhibit lipid peroxidation. The study found that the kernel extract was more effective than the seed-coat and pulp extracts. The pulp extract, enriched with anthocyanins, was specifically tested for its potential to inhibit iron (FeSO4)-induced lipid peroxidation in various rat organs (liver, mitochondria, brain, testes, etc.) in vitro. At a concentration of 5 ppm, the pulp extract showed significant lipid peroxidation inhibition, with the highest effect observed in liver mitochondria (86%), followed by the liver (83%), testes (72%), and brain (68.3%). Additionally, oral administration of *S. cumini* seed extract for 15 days to alloxan-treated rats resulted in increased antioxidant enzyme levels and reduced lipid peroxidation activity.

16. Neuropsychopharmacology actions[33-34]

Neuropsychopharmacology studies encompass a wide range of psychiatric and neurological conditions, including anxiety disorders, affective disorders (such as depression), psychotic disorders, degenerative disorders (like Alzheimer's disease), eating behaviors, and sleep behaviors. Research has shown that ethanolic extracts of *Syzygiumcumini* (black plum) demonstrate anti-amnesic effects against spatial memory impairments induced by scopolamine in rats. Additionally, methanolic and ethyl acetate extracts of *S. cumini* seeds were evaluated for their central nervous system (CNS) activity using rota-rod and actophotometer tests at doses of

200mg/kg and 400mg/kg. Significant CNS activity was observed for both extracts, indicating potential neurological benefits.

17. Radioprotective effects[35-38]

Radioprotective agents mitigate radiation's impact on tissues. S. cumini leaf extracts shielded against gamma radiation-induced damage to intestinal mucosa across varying radiation doses. Intraperitoneal administration of dichloromethane leaf extract and hydroalcoholic seed extract from S. cumini demonstrated radioprotective effects. In laboratory settings, S. cumini leaf extract at different concentrations (ranging from 0.0 to 100 μg/ml) reduced radiation-induced DNA damage in human peripheral blood lymphocytes.

18. Blood purifier

Jamun is rich in iron; hence as expected, it truly acted as a blood purifier, when studied by Katiyar et al., 2007[2], and there was enough production of haemoglobin, thus confirm folklore claim of hematinic. Hence its action as a protective food for menstruating women is justifiable.

Brito et al., 2007[14] also confirmed that due to impairment of eotaxin and IL-5 production, there was an anti-eosinophill effect of leaf extracts on Jamun.

19. Anti-arthritis effect

Eshwarappa et al., 2014[39] conducted an experiment and reported that *Jamun* leaf extracts can be used for the management of arthritis because of antioxidant property of *S. cumini*.

Nanotechnological applications:[40-44]

Nanotechnology is currently gaining significant attention for its potential in material sciences at the molecular level, particularly in the production of silver nanoparticles (AgNPs). Syzygiumcumini (Jamun) seed extract serves as a reducing agent for nanoparticle synthesis,

while the leaf extract is utilized as both a capping and reducing agent. The formation of these nanoparticles is typically confirmed using technologies such as UV-Vis spectrophotometry, Atomic Force Microscopy (AFM), and Scanning Electron Microscopy (SEM). The antimicrobial properties of these silver nanoparticles have been tested against Escherichia coli MTCC 1302, Staphylococcus aureus MTCC 740, Pseudomonas aeruginosa MTCC 2295, and Bacillus licheniformis MTCC 9555, as reported by Ram Prasad et al.

Compared to conventional methods, the green synthesis of metal nanoparticles using Jamun extracts is advantageous due to its simplicity, sustainability, non-toxicity, cost-effectiveness, and energy efficiency. Additionally, these synthesized metal nanoparticles show promise as aflatoxin adsorbents, potentially aiding in the detoxification of aflatoxin B1 in food and feed. Recent research by Asghar et al. also highlights the formation of iron (Fe), copper (Cu), and silver (Ag) nanoparticles using Syzygiumcumini leaf extracts.

Green synthesis of nanoparticles using jamun seed extracts[45]

Jamun seed extracts were found much suitable for green synthesis of silver nanoparticles and this was attributed to presence of high amounts of polyphenols and highly polar soluble constituents in jamun seed extracts. The generated silver nanoparticles were found to greatly reduce the glucose-induced cardiac stress in vitro.

Biotechnological potential

1. Antigenotoxic properties[43-44]

Ethyl acetate extract of *Syzygiumcumini* seed ameliorate the mutagen induced DNA damage in lymphocytes, and also protected pBR 322 plasmid DNA from oxidative damage. This fraction also showed strong antimutagenic activity in the Ames' test. Both were attributed to presence of flavonoids like rutin in the seed extract. Kavital et al., reported considerable antioxidant and anti-

inflammatory activity of the seed extracts. Oral supplementation in rats with JS extract boosted the activity of antioxidant enzymes (superoxide dismutase, catalase and glutathione peroxidase) and lowered the concentrations of TBARS and TNF-α. Significant hepatoprotective, antigenotoxic and anti-oxidative effects of the seed extracts were reported against arsenic exposure in wistar rats. Seed extracts showed anti-inflammatory activity against induced oedema in wistar rats.

2. Antibacterial activity[46-47]

Solvent extracts of the seed showed significant inhibitory effect on the growth of various pathogenic bacteria like Staphylococcus aureus and Bacillus subtilis. Proteome analysis of phenol extracts of the jamun seeds by MALDI-TOF, allowed identification of several proteins in the seeds, which are known to have metabolically important functions. One of these identified proteins, lactoferrin, showed strong inhibition of bacterial growth. Bacteriostatic action of the seed extracts was also reported by Bhusariand devi et al., against both gram+ and gram – pathogens. The phenolic extracts of the seed and pulpwere found to have antibacterial activity indifferent types of assays, inhibition of swarming motility, reduction of biofilm formation as well as antiquorum sensing activity. Active films incorporating these extracts inhibited the growth of P. fluorescens, L. monocytogenes, and S. aureus, as well as QS in C. violaceum, indicating potential applications in food preservation and packaging. Molecular docking studies in silico, with several components of the extract also indicated interference with bacterial quorum sensing.

3. Hypoglycemic activity[43]

Seed extracts were found to inhibit the *α-amylase* and *α-glucosidase* enzymes during*in-vitro*analysis and lowered the blood glucose levels in wistar rats, in studies carried out by Kavital

et al.,while the *in silico* docking studies of some of the components of the extracts like 1,2,3-Benzenetriol, indicated highbinding affinity for human pancreatic *α-amylase*.

Discussion and Conclusion

Considering the strong folklore traditional claims of Asian countries and various medico-pharmaceutical applications necessitate justification towards the exploration of different plant parts of *Syzygiumcumini*, yet more comprehensive studies are further required, and seed part need camouflaging. Antibiotic resistance is an emerging challenge to mankind andantibacterial activity and antigenotoxic ability. The phytoconstituents from Jamun seed extracts could have potential application in agriculture and animal husbandry against pathogenic bacteria, and can also be further explored in food preserving and packaging purposes.

Pain and inflammation are associated with various pathophysiological conditions and search of novel antinociceptive activity is an ongoing procedure for blocking the painful or injurious stimulus by sensory neurons. Based on traditional and therapeutic indications of *Syzygiumcumini* plant preparations, phytopharmaceutical products could be developed also for the patients of diabetics, cancer, arthritics. Folklore claims and traditional use of S. cumin plat parts, specially seeds for providing protection to the liver was also conferred by Sumaiya Nahid et al.[49] and Mastan et al.[50] Therefore, the seeds of *Syzygiumcumini* have futuristic potential through biotechnological tools in the development of novel nano-medicinal products useful for liver related disorders and to counter the hepatotoxic effects of chemotherapeutic-cytotoxic agents

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