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ETHNOPHYTOPHARMACOLOGICAL BENEFITS OF *SYZYGIUM CUMINI*: POTENTIAL PLANT IN CURING AILMENTS

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ABSTRACT

Herbs has been used since ancient times for curing many diseases due to their lesser to fewer side effects that is because of their habitat and environmental conditions. Many herbs and plants has been used in treating diseases concerning to diabetic, anti-inflammatory, arthritis, bowel infection, etc for the betterment of human race. Among them one plant *Syzygium cumini* is the most commonly used medicinal plants to its extent. *Syzygium cumini* which is known as Jamun or black plum belongs to Myrtaceae family and possess many beneficial effects. In context to current report a detail profiling on its chemical constituents has been looked upon. The plant possesses rich phytoconstituents, like, alkaloids, carbohydrates, fatty acids, flavonoids, minerals, phenols, hormones, tannins, terpenoids and vitamins. Scientific studies have revealed that the different extracts of the plant has a wide range of pharmacological components, such as antibacterial, antifungal, antioxidant, anti-inflammatory, neuropsychopharmacological, antiviral, nitric oxide scavenging, anti-cancer, free radical scavenging, anti-diarrheal, anti-fertility, anorexigenic, gastroprotective, anti-ulcer, radioprotective, anti-hermitic and anti-ulcer activities.

The presence of various phytochemicals and its related pharmacological activities has been highly effective in treating various aliments which are of greater concern. Thus this fundamentally important information processed will be beneficial to many researchers for an eye-opener to discover the responsible active components with its mechanism to target the cells and helps in the mechanism of strengthening the immune process.

Keywords: *Syzygium cumini*, System of Medicine, Traditional Uses, Scientific uses, Secondary Metaboloites, Chemical Constituents and Pharmacological actions

INTRODUCTION

The usage of medicinal plants and herbs are from ancient times which possess beneficial effects to treat human diseases with lesser side effects. The Indian System of Medicine beliefs in curing ailments with the healing power of herbs which results in holistic approach. In line with the system Traditional System of Medicine (TSM) also define the same features which are seen in various system like Siddha, Unani, Homeopathy and Ayurveda that has provided better health care principles when followed in a regular pattern. Owing to the importance of the system and usage one of the plants is Syzygium cumin. The geographical location of the plant has spread its wings throughout Asia, Nepal, Srilanka, Bangladesh, Indonesia, and Malaysia and also in many tropical countries like West Indies, East, and West Africa, and in some subtropical regions like Florida, California, Algeria, and Israel **[1]**. The plant both folklore and modern is believed to have numerous potentiality in treating various diseases. Hence in the present study more envisage is laid on the medicinal value, phyto constituents and pytopharmacological effects of the plant and its extracts.

BOTANICAL DESCRIPTION

The plant is a rapid growing large evergreen tree with thick greyish-brown bark or greyish-white stems which grows up to a height of 25 M. It is a densely foliaceous tree. The leaves are opposite, elliptical, flat, shiny, and have a texture of leathery. The timber or the hard wood is whitish to close-grained. The durability is less and due to which a gum is released known as Kino gum. The leaves are generally 6 to 12 centimeters long, oblong-ovate to elliptic, or obovate-elliptic in shape **[2]**. The panicles are auxiliary or terminal and are seen from the branchlets below the leaves which ranges from 4 to 6 cm long. Flowers are seen in clusters which are few to 10 to 40 are fragrant, with greenish-white, round or oblong and are in dichotomous paniculate

cymes pattern. The calyx is of funnel-shaped, toothed, 4 mm in length in its appearance. The petals are arranged in disc form, cohered with each other and fall all together. Stamens are multiple and roughly as long as the calyx **[3]**. Sometimes obviously oblong, 1.5 to 3.5 centimeters long, dark-purple or almost black, luscious, fleshy, and edible, the fruits are berries and contain a single large seed. The plant produces small purple plums with a very sweet taste that, as the fruit matures, becomes slightly astringent on the edges of the pulp. The dark purple-colored ripe fruits give the appearance, both in weight and form, of the fruit of the olive tree and have an astringent taste. The fruit has a sweet, slightly sour, and astringent flavor combination and appears to colour the tongue purple **[4]**.

PHYTOCHEMISTRY

The plant *Syzygium cumini* is found in various parts of the world serve as a rich source of tannins, alkaloids, carbohydrates, flavonoids, sterols, glycosides, and other phytoconstituents. These phytochemicals may be responsible for their promising therapeutic values and may help cure illnesses in humans. **Tables 1 and 2** lists the scientifically-proven chemical constituents of *Syzygium cumini.*

Traditional uses

Different plant parts of *Syzygium cumini* such as seeds, fruits, leaves, flowers, barks are commonly used in folkflore medicines which hold its importance in system of medicine like Ayurveda and Unani. The **Table 3** depicts the traditional uses along with its plant parts.

Table 1: Phytoconstituents Isolated From Different Parts of *Syzygium cumini*

Plant parts	Metabolic Class of constituents compounds	Isolated active Identified
Stem bark	Triterpenoids, Resin, Phytosterol Ellagic acid, Pentacyclic triterpenoid	Pentacyclic Triterpenoid Friedelin, Myricetine, β- sitosterol, Myricyl alcohol [1]
Leaves	Phenolic and Glycosides	Ferrullic acid, Catechin, mycaminose, Quercetin, tocopherol, galloyl carboxylase [5,6]
Seeds	Polyphenols	Cretegolic acid, n-dotricontanol, Myrcetin, tannic acid, tocopherol [7, 8]
Fruits	Tannins, Glycosides Vitamin A, C	Raffinose, Fructose, Citric Acid, Gallic acid, Malic Acid, Riboflavin, Malvidin, Folic Acid, Petunidin [9]
Fruit Pulp	Anthocyanins, Terpenes	Petunidin, α-pinene, β- pinene, Cyanidin, Delphinidin [10]
Flower	Flavonoids, Tannins	Erategolic acid, isoquercetin, Eugenol- triterpenoids, Oleanolic acid, Mycertin-3-L-arabinoside [11]
Roots	Flavonoids	Isorhamine 3-o-rutinoside, Myricetin 3-o-robinoside [12]

Table 2: Phytoconstituents Present in Extracts of *Syzygium cumini*

Active constituents	Extraction part	Reported result
Tannins, alkaloids, flavonoids, sterols, carbohydrates and glycosides	Leaves	Catechin and Ferulic acid were found to be present in the leaf extracts which showed a potent antioxidant activity [2]
Tannins	Bark	They were found to be rich in plant part and possessed gastroprotective and anti-ulcerogenic properties [13]
Alkaloids, Flavonoids, Saponins Tannins, Glycosides, Proteins	Leaves	Presence of protein substances were at their maximum in all the extracts [14]
Phenols, Flavonoids, Anthocyanins	Fruits	Phenol content was found to be Maximum when compared with Flavonoid and Anthocyanin [15, 16]
Alkaloids, Saponins, Tannins Flavonoids, Steroid's	Seeds	Saponins and Flavonoids were in high quantity in seed extract [17]
Phenols and Flavonoids	Leaves, Seeds, pulp	Both the contents were maximum in leaves followed by Seeds and pulp [18]
Phenols, Flavonoids	Leaves, Barks	The content was found to be maximum in methanolic extract of leaf as compared to Bark part [19]
Essential Oils	Flowers	The presence of β-caryophyllene and caryophyllene oxide showed a significant anti-inflammatory and antimycobacterial action [20]
Alkaloids, Saponins Proteins, Tannins	Leaves	The presence of metabolites showed a significant antioxidant activity against the concentration of 106.34ug/mL [21]
Carotenoids	Fruits	Highest amount of the metabolite was found in the pant part [22]

Table 3: Traditional Uses of *Syzygium cumin*

Plant part	Traditional uses
Barks	The bark is used as astringent in Charaka. In Sushruta, it is also used as astringent and its juice is given in the treatment of chronic dysentery, diarrhea, and menorrhagia. The decoction of the bark is generally strong in mouth-related issues, for example, mouth wash and swish for treatment of light gums, stomatitis, loosened up the throat, and other disease [23]. Bark is also effective for the treatment of inflammation of the skin Bark is also used in dyeing and for coloring fishnets As per Ayurveda, it is utilized as acrid, sweet, stomach related, astringent to the bowels, anthelmintic, and useful for sore throat, bronchitis, asthma, thirst, biliousness, loose bowels, blood debasements and to fix ulcers [23]
Leaves	The juice of Jamun, Amra, and Amalaka leaves blended in with goat milk and honey is prescribed in the treatment of the chronic condition of diarrhea. Jambolin leaf extract taken orally shows hypoglycemic action in diabetic patient diabetes. The juice is taken blended in with milk each day. Fresh leaf removal is taken orally in the early morning is utilize fully in stomach torment and fix ulcer [24]. Traditional healers in Brazil use tea obtained from implantation/decoction of leaves when taken orally for diabetes [25]. In Southern Brazil leaves (either infusion or decoction in water) at an average centralization of 2.5 g/L; mean every day admission of around 1 liter is utilized for diabetes [26]. In Northeast India, the juice of leaves is given orally as an antitoxin in Opium harming and centipede bite [26]
Seeds	The seeds extract was used for the treatment of mouth sores, ulcers, and Dysentery. The Seeds are also used for GIT digestive-related problems. The seed powder combination with mango kernels was orally administered to treat chronic diarrhea condition [27]
Fruits	The organic products are utilized in Siddha, Ayurveda, Unani other than other folkloric utilizes in India as a stomachic, astringent, antiscorbutic, diuretic, antidiabetic [27]. In Sushruta fruit is prescribed for internal obesity, vaginal discharge, and menstrual disorders [28]

PHARMACOLOGICAL USES OF *SYZYGIUM CUMINI*:

Syzygium cumin possess various pharmacological activity like antidiarrhoeal, antioxidant, gastroprotective, antiallergic, astringent, analgesic, anti-inflammatory, antiplaque, and antimicrobial including anti-diabetic potentiality.

Anti-diabetic Activity: Diabetes normally considered as a silent killer and chronic metabolic disorder that affects the major population of the world. Various clinical and preclinical studies have been performed on *Syzygium cumini* plant to evaluate the anti-diabetic potentiality. Several scientific studies performed on different parts of *the Syzygium cumini* plant such as seeds, fruit pulp, bark extract, flowers, leaves, and whole plants that all show anti-diabetic activity. Studies conducted by *Khan, et al.* from the decoction of aerial parts of *Syzygium cumini* plants, when taken orally by adults at a dose (500mg/ person) was effective as an anti-hyperglycemic agent. Ethanolic extract and aqueous extract of *Syzygium cumini* showed a significant hypoglycemic effect on alloxan-induced diabetic rats **[29]**. According to the studies laid down by Jain and Sharma, the hot aqueous extract of dried fruit pulp showed antidiabetic effect when (5mg/kg) administered by oral gastric intubation **[30]**. *Ratsimamanga et al*. investigated that the ethanolic concentrate of the bark of Jamun diminished glucose level by 21% following one hour in hyperglycaemic rabbits active compound isolated from *Syzygium cumini* seeds at 200mg/kg to 400mg/kg showed a significant effect. It decreases the blood glucose level in streptozotocin-induced diabetic in rats **[31]**.

Antiallergic Activity: Allergy is the abnormal reaction in the body to the allergen caused by the ingestion of unwanted substances, by inhalation, injection, and contact by the skin. In several investigations, it had been proven that the aqueous extract of *Syzygium cumini* leaves gives an antiallergic effect. It is also revealed that the edematogenic effects of allergy are mainly due to allergens which inhibit the histamine secretions, serotonin effects, and mast cell degranulation **[32]**.

Gastroprotective Activity: Natural herbs are considered to be safe and effective in all treatment of diseases and one such is the protection of gastric mucosa from aggressive irritating agents that damage the lining of the stomach. The impact of ethanolic concentrate of seed extract of *E. jambolana* against gastric ulcers induced by cold pressure, pylorus ligation, ethanol, indomethacin, and anti-inflammatory medicine prompted gastric

ulcers in rodents. It was observed that a significant decrease in ulcerative index in rat stomach after the oral administration of Syzygium cumini extract or mix with acarbose 5mg/kg. The ulcer defensive action might be because of its protective elements and cancer prevention agent properties **[33]**.

Antioxidant Activity: Ethanolic extract of *Syzygium cumini* plant seeds kernel played an essential role in the prevention of free radicals initiated various diseases like cancer, aids, arthritis, Alzheimer's, and diabetic tissue damage diseases. The leaves and fruits kernel of *Syzygium cumini* showed significant antioxidant activity also seen by using *in vitro* method, hydroxyl revolutionary rummaging test, because of the benzoic corrosive hydroxylation strategy, superoxide extremist – screening test, given photochemical decrease of nitroblue tetrazolium (NBT) within the sight of a riboflavin light – NBT framework, DPPH extremist searching examine, and lipid peroxidation test. The cell reinforcement property of the skin of the fruit may be exhibited due to various nutrients like, phenolics, or tannins and anthocyanins present in the fruit 34. The cancer prevention agent movement of leaves of *Syzygium cumini* utilizing 2,2 diphenyl - 1-picrylhydrazyl (DPPH) free extremist rummaging and ferric – decreasing cell reinforcement power (FRAP) examines. The methanolic concentrate and its four water, ethyl acetic acid derivation, chloroform, and n-hexane part were arranged and exposed to antioxidant evaluation **[34]**.

CNS Activity: Neuropsychopharmacological agents include investigations of anxiety issues, emotional problems, psychotic issues, degenerative issues, eating behavior, and rest sleep behavior. The various extract, divisions, and subfractions obtained from the seeds of *Syzygium cumini* plant for behavior perception impacts in mice, with respect to narcotic, sedative and anticonvulsant activities

The extract exhibited the antiamnesic activity against scopolamine-induced spatial impairments in rats. The methanolic and ethyl acetate extract of seeds at doses of 200 mg/kg and 400 mg/kg when administered in the mice by oral route were evaluated for their CNS activity by using rotarod and actophotometer apparatus which possessed a significant CNS activity. Hydroalcoholic extract of *Syzygium cumini* seed kernels was also found to be effective in anticonvulsant action in pentylenetetrazol-and maximal electroshock-instigated spasms, as compared to hypothermic impact. The ethyl acetic acid derivation portion and its subfractions

upgraded latency and duration of the first convulsion instigated by pentylenetetrazol. *Syzygium cumini* had some dynamic standards with focal depressant properties **[35]**.

Anti-inflammatory Activity: The anti-inflammatory drugs are those drugs that help to reduce or overcome a local physical condition in which some portion of the body gets blushed, swollen, hot, and painful, particularly as a response to injury or contamination. According to scientific studies, the leaves and seeds have investigated that dose administered in rats by oral route (doses 200 to 400 mg/kg p.o.) showed significant effects in anti-inflammatory activity with inducing carrageenan-induced paw edema model in Wistar rats **[36]**. The ethanolic extract of bark of *Syzygium cumin* possess effective for anti-inflammatory activity. The extract of bark didn't show any kind of poisonous indication up to a dose of 10-125 g/kg.i.p. in mice **[37]**.

Antihyperlipidemic Activity: Unusual lipid profile is one of the most well-known difficulties in diabetes mellitus. Various lipid-lowering management drugs are available in the market, but herbal drugs are the safest and efficacious drug. The anti-hyperlipidemic potential of *Syzygium cumini* fruit pulp was evaluated in diet-induced hyperlipidaemic rats. The fruit pulp was more potent as compared to simvastatin in reducing serum LDL cholesterol, triglycerides & total cholesterol, and elevating HDL cholesterol. Oral administration of ethanolic concentrate of *E. jambolana-bit* (100mg/kg body weight) demonstrated antihyperlipidemic action on streptozotocin-incited diabetic rodents and the standard medication was glibenclamide **[38]**.

Antifertility Activity: Oleanolic acid acts as a potent constituent isolated from the flowers of *E. jambolana* which essentially diminished the fertilizing capacity of the male albino rats rodents with no critical change in body or reproductive organ weight. It caused a huge decrease in the change of spermatocytes to spermicides and captured spermatogenesis at the beginning phases of meiosis prompting a decline in sperm tally with no anomaly to spermatogenic cells and Sertoli cells **[39]**.

Anti-diarrhoeal activity: Oral administration of ethanolic extract at a dose of 400 mg/kg of *Syzygium cumini* generally reduces the gastrointestinal action against various test models of loosen the bowels in rodents. It creates a critical restraint to castor oil-induced which looseness of the bowels

and PGE-initiated into a pooling and a huge decrease in gastrointestinal motility in charcoal meal tests in rats **[40]**.

Antiplaque activity: The aqueous, methanolic, and methanol-water (1:1) concentrates of the bark and orally ready extract was administered to suppress plaque arrangement *in vitro*. All were found to be effective against *Streptococcus* mutants at a dose of 260,120, and 380 µg per ml respectively **[41].**

Antipyretic activity: It is stated that chloroform extracts of dried seeds showed maintenance of the body temperature. It was observed that the methanol extracts of dried seeds administered intraperitoneally to rats at doses of 50 mg per kg were active to control yeast-induced pyrexia **[42]**.

Antispasmodic activity: The studies carried out with ethanol-water (1:1) extract of the aerial parts of *Syzygium cumini* plants extract was found to be inactive in guinea pig ileum against histamine and acetylcholine-induced spasms **[43]**.

Antihistamine activity: The inflammation in the pedal edema was reduced when the wistar rats were intraperitoneally administered with histamine in histamine-induced pedal edema model **[42]**.

Antiviral activity: The concentrate of the entire plant when infused into a contaminated chick undeveloped organism at a portion of 1.0 mg/creature was inactive on Ranikhet and vaccinia infections. Infected chick undeveloped organism embryo viral titer diminished by 10% and 0%, separately. The ethanol/water (1:1) concentrate on the flying parts at centralization of 50.0 mcg/ml in cell culture was likewise dormant on Ranikhet and vaccinia infections **[44]**. The cold and hot watery concentrates of leaves and barks of the plant were assessed for their antiviral potential against the avian flu infection (H5N1) which caused an exceptionally infectious sickness of poultry. The ethanol-water (1:1) ratio concentrate of the dried whole plant at centralization of 0.1 mg/ml in cell culture was inert against Ranikhet infection and vaccinia virus45. However, water concentrate of the bark of *Syzygium cumini* was dynamic on potato X virus **[45]**.

Antibacterial activity: Essential oil present in the leaves of *Syzygium cumini* exhibited good antibacterial activity.. Aqueous extract of dried leaves of *Syzygium cumini* had shown beneficial effects against *Klebsiella sp., Salmonella paratyphi A & B, Citrobacter sp., Proteus mirabilis, Escherichia coli, Staphylococcus aureus, Shigella sonnei, Pseudomonas aeruginosa, Salmonella typhimurium, Shigella boydii, Streptococcus faecalis, Shigella flexneri* and *Salmonella*

typhi. Ethyl acetate, petroleum ether, and methanol extracts of the *Syzygium cumini* leaf were found to be effective against *Pseudomonas aeruginosa, Staphylococcus aureus, Salmonella typhimurium, Bacillus subtilis,* and *Enterobacter aerogenes* **[46]**. The antibacterial action of methanol and ethyl acetic acid derivation concentrates of dried seeds of *Syzygium cumini* at centralization of 200 µg/plate best against five Gram-positive microscopic organisms (*Bacillus cereus, Bacillus subtitles, B.megateriun, Streptococcus ß – haemolyticus, S. aureus*) and other nine Gram-negative microbes (*Shigella dysenteriae, Sh. Shiga, Sh. boydii, Sh. flexneriae, Sh.sonnei, E. coli, S. Typhi B, S. Typhi B-56, and Klebsiella species*) by disc diffusion method **[47]**.

Antifungal activity: As indicated that the bark of *Syzygium cumini* had a more powerful antifungal movement in correlation with leaf separate against *Rhizoctonia solani*. The prepared concentrates of bark and leaves of *Syzygium cumini in* methanol at focuses viz. 1%, 2%, 3%, 4% and 5% were tried against the objective microorganism. It was discovered that methanolic bark concentrate of *Syzygium cumini* more compelling and demonstrated high antifungal potential when contrasted with leaf extract **[48].**

Cardio-protective activity: The hydro-alcoholic concentrate of *S. cumini* plants was assessed for its antihypertensive. Poly-ethylene catheters were embedded into the substandard vena cava and lower stomach aorta in the anesthetized rodents for dosing and estimating pulse. The concentrate at the portions of 0.5 1; 5; 10; 20 and 30 mg/kg, i.v. had the option to instigate hypotension, due to a decrease in endothelium interceded fringe obstruction and bradycardia [**49]**.

Anti-cancer activity: They arranged various concentrates like hexane, chloroform, ether, ethyl acetic acid derivation, ethanol, and water remove for assessment of the anticancer action of *Syzygium cumini* fruits extract utilizing cell viability measure of leukemia malignancy cell line. It revealed that the ethanol portion removes a displayed a more grounded enemy of leukemia movement when contrasted with different ones concentrate. The dynamic elements of *Syzygium cumini* disconnected from ethanol natural product remove contained phenolic mixes specifically Kaempferol 7-O-methyl ether and sterols, for example, γ-Sitosterol which were answerable for their anticancer activity **[50]**.

Chemoprotective activity: To protect healthy tissues from the adverse effects of anti-cancer medications, numerous herbal

products have shown their beneficial effects. The chemoprotective function was demonstrated in the *in vivo* oxidative stress and genomic damage of the aqueous and ethanolic extracts of *Syzygium cumini* seeds **[51]**. Scientists reported that seeds of *Syzygium cumini* extract at a dose of 125 and 250 mg/kg administered orally exhibited the cancer chemo-preventive properties in the DMBA-induced croton oil and stimulated two stages of skin carcinogenesis in Swiss albino mice. The seed extract was also found to be able to minimize the occurrence of tumors, the total number of papillomas, and increase the average latency time relative to the control group [**52]**.

Anti-amnesic effects: The extract that reduced partial memory impairment at doses of 200 mg/kg BW and 400 mg/kg BW when tested with scopolamine induction (1 mg/kg, i.p.) in rats. A more prominent effect was seen at a dose of 400 mg/kg compared to a dose of 200 mg/kg. These findings suggested that by inhibiting acetylcholinesterase and antioxidant functions in the brain, the methanolic extract could exert anti-amnesic activity **[53]**.

Anti-fatigue activity: Different preparations of solvent extracts, such as aqueous, methanolic, and ethyl acetate extracts from *Syzygium cumini* leaves, were tested for 21 days in rats. In swimming endurance and post-swimming anti-fatigue studies, extracts at doses of 200 to 400 mg/kg body weight were capable of increasing tolerance for non-specific stress. Gallic acid was an active constituent and it responsible for anti-fatigue activity **[54]**.

Platelet and Leukocyte-increasing effects: The methanolic extract of leaves increased the number of platelets at doses of 400 mg/kg and 800 mg/kg and of leukocytes at doses of 800 mg/kg in Sprague-Dawley rats **[55]**.

CONCLUSION

Hence*, Syzygium cumini* plant is regarded as a magic remedy in Indian medicinal literature for numerous disease. This review has focused on recent investigations carried out by many researchers on the diverse pharmacological actions of *Syzygium cumini* in various disease treatments and management. Majority of the scientist identified the therapeutic activity in the crude extract of *Syzygium cumini* plant, but very less study has been performed on isolated components of the plant. Henceforth the present review was found to be inlined on the important therapeutic medicinal plant *Syzygium cumini* which will be beneficial for further research on the isolation of bioactive constituents followed by appropriate formulation and standardization. Phyto-

chemical and clinical studies can be trailed out more for the discovery of safer drugs which in turn would be related to broader possible application of the plant with a well-established model of action for all pharmacological possible that has been examined.

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