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MORPHOLOGICAL, PHYTOCHEMICAL AND PHARMACOLOGICAL ASPECTS OF *SYZIGIUM CUMINI*

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ABSTRACT

Syzygium cumini, family Myrtaceae, a medicinal plant with numerous pharmacological activities such as anti-diabetic, antioxidant, anti-hyperlipidic and hepatoprotective. Seeds are moderately rich in protein and various phytochemicals along with flavonoids quercetin and, rutin a well-known antioxidant. Its leaves are used to treat leucorrhoea, stomachache, fever, dermopathy, constipation, inhibit blood discharge in feaces and reduce radiation induced DNA damage. Jamun fruit is an effective food remedy for bleeding piles and correcting liver disorders. This will help in confirmation of traditional use along with value-added utility of plant eventually leading to higher revenues from the plant.

Keywords *– Syzygium cumini, Phytochemical, Pharmacological properties, Medicinal plants.*

1. INTRODUCTION

In the pandemic situation, research on use of medicinal plants is increased in order to search various pharmacological activities of plants [1-11]. *Syzigium Cumini*, family Myrtaceae is a native tree to India and a common traditional medicinal plant [13]. It is also known as Jaya plum, poofugese plum, Molbar plum, Black plum, Indian blackberry, jamun, etc [14]. It is found in Eastern Africa, Southern America, Madagascar and warmer regions of the United States of America. It is a plant whose parts have been numerous pharmacological effects [15]. Its fruits are used in Siddha, Ayurveda and Unani medicinal systems. Jamun fruit is an effective food remedy for bleeding piles and correcting liver disorders [16-17].

A long-term endocrine metabolic disorder characterized by hyperglycemia is commonly known as diabetes. This endocrine disorder is due to disturbances in metabolism of carbohydrate, protein and fat either in secretion and mode of action or both of insulin. Non-insulin dependent (type II) diabetes is more common and reaching 90–95% of the population. It is a multi-factorial disease and the current strategy used for the treatment is a combination of an insulin secretagogue and an insulin sensitizer [18-19] **(Table 1).**

Table 1: Taxonomy of the plant

Classification	Name
Botanical Name	*Syzygiumcumini*
Family	Myrtaceae
Genus	Syzygium
Species	*S.Cumini*
Order	Myrtales

2. HISTORY AND DISTRIBUTION

Syzygium cumini (S. cumini) is one of the bestknown species and it is very often cultivated. The synonyms of *S. cumini* are Eugenia jambolana Myrtuscumini, Syzygium jambolana, Syzygium jambolanum, Calyptranthes jambolan, Eugenia cumini and Eugenia caryophylli folia [20]. It is commonly known as jambolan, black plum, jamun, java plum, Indian blackberry, Portuguese plum, Malabar plum, purple plum, Jamaica and damson plum. For long in the period of recorded history, the tree is known to have grown in the Indian sub-continent, and many others adjoin regions of South Asia such as India, Bangladesh, Burma, Nepal, Pakistan, Sri Lanka and Indonesia [21].

3. PHYTOCHEMISTRY

Medicinal plants exert their pharmacological actions and therapeutic uses through the active chemical constituents or secondary metabolites present in the plant parts. The plant is reported to have flavonoids, glycosides, phenolic compounds, anthocyanins, ellagic acid, quercetin, myricetin, kaemferol and jambolin by various extraction and spectroscopic methods [22].

Jamolan is rich in compound containing anthocynins, ellagic acid, isoquercetin, kamoferol and myercetin while Java pulms are rich in sugar, mineral salts, vitamin C, PP which fortifies the beneficial effect of vitamin C, anthocynins and flavonoids. Phytochemical contents present in different parts of *S. cumini* are as following [23-35].

3.1. Seeds: Seeds have been reported to be rich in alkaloids, jambosine and glycoside jambolin or antimellin as well as rich in flavonoids,well known antioxidants and fairly rich in protein and calcium. It stops conversion of starch to sugar and very helpful in high blood pressure. It also accounts for the scavenging of free radicals and protective effects as antioxidants.

3.2. Leaves: Leaves are rich in acylated flavonol glycosides, quercetin, myricitin, myricetin, 3-o-4-acetyl-L-rhamnopyranoside.

3.3. Stem bark: Bark are rich in friedelin, epifridelanol, β-sitosterol, quercetin kaempferol, myricrtin, gallic acid and ellagic acid, bergenins, flavonoids and tannins. The most important is a presence of gallo- and ellagi-tanninswhich may be responsible for the anti-astringent property of stem bark.

3.4. Flowers: The flowers are rich in kaempferol, quercetin, myricetin, isoquercetin, myricetin-3-L-arabinosode, quercetin-3-D-galactoside, dihydromyricetin, oleanolic acid, eugenol-triterpenoid A and B.

3.5. Roots: Roots of *S.cumini* are rich in flavonoid glycosides and isorhamnetin 3-O-rutinoside.

3.6. Fruits: Fruits are rich in raffinose, glucose, fructose, citric acid, mallic acid, gallic acid, anthocynins, delephinidin-3-gentiobioside, malvidin-3-laminariboside, petunidin-3-gentinobioside, cyaniding, diglycoside, petunidin and malvidin.Its sourness may be due to presence of gallic acid and colour may be due to presence of anthocynins.

4. ANALYSIS OF PHYTOCONSTITUENTS

There are various methods of analytical methods commonly used for various analysis of phytoconstituents. These methods include UV-spectroscopy, HPTLC, HPLC, gas chromatography, etc. [36-79].

5. ACUTE AND SUB-ACUTE STUDIES

The thorough toxicological studies of plant extract in preclinical models are very essential to ensure safety and tolerability of the extract for human use. The following recent studies using both mice and rats suggest that the plant's parts and its various extracts are safe to use in a clinical set-up [80-85].

5.1. Toxicity studies with bark extract

Evaluation of acute and repeat oral toxicity studies for aqueous extracts of SC bark at various doses in both mice and rats as per OECD guidelines were reported. This study provides sufficient preclinical evidence of safety for aqueous extract of SC stem bark. Acute toxicity study of petroleum ether, chloroform, ethanol and aqueous extracts SC stem bark using Wistar rats suggest that all four extracts were well tolerated up to 5000 mg/kg dose by the oral route [86].

5.2 Toxicity studies with leaves extract

Acute toxicity studies to determine the LD50 of hydro-alcoholic (HE) extract of SC leaves in mice and rat by oral and intra-peritoneal (IP) routes were reported. There is no oral toxicity occurred but the intra-peritoneal route administration of HE extracts in mice caused death of animal and the reported LD50 for mice is 0.489 g/kg by route [87-88].

5.3. Toxicity studies with seed extract

Acute toxicity studies involving ethyl acetate and methanol extracts of SC seeds in rats as per OECD423 guidelines found to be safe up to the dose of 2 g/kg with no mortality. Evaluation of aqueous extract of SC seed for acute toxicity profiling suggest that single dose of 500mg/ml/kg of the extract was well tolerated with no clinical signs of toxicity or deaths were reported during the monitoring period (up to 14 days) [89-90].

6. **PHARMACOLOGICAL ASPECTS**

A recent clinical trial study using 49 patients diagnosed with type 2 DM in a double blind randomized controlled trial administered with 10g/day SC seed powder over 90days period for lowering of high blood pressure associated with type 2 DM condition. Finding from this clinical trial study suggested that SC seed powder exhibits blood pressure lowering effect and significantly lowered the blood pressure associated with patients with type 2 diabetes mellitus in addition to its known blood sugar lowering effects and improves overall health of diabetic patients [91].

The above studies indicate that crude drug powder of SC shows beneficial antidiabetic activity and is well tolerated but needs a higher dose. Such doses may not be practically implementable. Hence trials need to be conducted on the suitable extracts after thorough toxicity studies [92]. Traditional uses are given in **Table 2**.

Table 2: Traditional uses of plant

Ethnic group and their origin	Preparation	Uses
Local people in South Brazil	Either infusion or decoction of leaves in water at an average conc. of 2.5g/L & drank it in place of water.	Daily intake of about 1L are used in treatment of diabetes.
Lakher and Pavi in North East, India.	Powder: (i) Bark mixture or infusion of fruit. (ii) Seeds are mixed with sugar.	(i) Fruits given orally to treat diabetes. (ii) Given orally 2 -3 times daily in treatment of dysentery.
	Juices: (ii) Obtained from the seeds. (iv) Obtained from the bark. (v) Leaves. (vi) Ripe fruits which are stored for 3 days.	(i) applied externally on sores and ulcers. (ii) Given orally for treatment of women with a history of repeated abortion. (iii) Given orally as antidote in opium poisoning and in centipede bite. (iv) Given orally for gastric problems.
Local informants in Maharashtra,India	Fruit and Stem bark.	Used in treatment of diabetes, dysentery, increase apetite and relive from headache.
Nepalese,Lepchas and Bhutias in Northest India	Decoction of stem bark	Taken orally 3 times a day for 2-3 weeks to treat diabetes.
Native Amerindians & Quilombolas in North Eastern, Brazil	Leaves	Used in treatment of diabetes and renal problems
Malayalis in South India	Paste of seeds is prepared with combination of leaves of momordicacharantia & flowers of cassia auriculata.	Taken orally once a day for 3 months to treat diabetes
Traditional medical healers in Madagascar	Seeds	Used for counteracting slow debilitating impacts of diabetes.
Andraprades, India	Shade dried powder of seeds	Taken thrice a day to treat diabetes.
Siddis in Karnataka, India	Juices: a) Of leaves mixed with milk b) Of Stem bark mixed with butter milk	a) Taken orally early in the morning to treat diabetes. b) Taken every day before going to bed to treat constipation.

7. PHARMACOLOGICAL ASPECTS

Plant and its parts have been used as an alternative and complementary medicine to regulate diabetes all over the world.

7.1. Anti-diabetic effect

Antidiabetic effect of plant has been used to control blood sugar level for more than 130 years in west however, clinical studies are mixed results. The results of preclinical studies shows that SC alleviates blood sugar levels. Plant has been evaluated in more than 100 research papers for antidiabetic activity using both in vitro and in vivo-models. As far as in vivo models are concerned, the studies are mostly conducted on Alloxan or streptozotocin induced diabetes that mostly mimic type-1 diabetes. However, there are few studies on high fat diet and streptozotocin inducted diabetes that closely resembles type-2 diabetes [93-94].

7.1.1. Type I diabetes mellitus

Type I diabetes mellitus also called as juvenile-onset diabetes mellitus because it often begins in childhood. In Type I diabetes mellitus, there is a destruction of β cells in pancreatic islets. In all type I cases, insulin in circulation is low or very low and patients are more prone to ketosis. This type is less common and has low degree of genetic pre-deposition.

7.1.2. Type II diabetes mellitus

Type II diabetes mellitus also called as maturity onset diabetes mellitus because it is an inherited form of diabetes mellitus. In Type II diabetes mellitus, there is a gradual deterioration of β cells. In these types, insulin circulation is low or normal or even high.

This type is more common and over 90% cases are of Type II diabetes mellitus. There is a high degree of genetic pre-deposition in this type.

7.2 Anti-hyperlipidemic activity

The diabetes and hyperlipidemia are usually associated with each other, which is a main cause of cardiovascular disorders. In diabetes-induced hyperlipidemia, increase in deposition of glucagon in skeletal muscle is most common due to insufficient supply of insulin and low amount of glucose is utilized. Seed showed anti-hyperlipidemic activity in streptozotocin-induced diabetic rats by normalizing the alterations in lipid profiles and restored them to near normal levels either by hydrolysis and selective uptake of lipoproteins or due to the presence of different phytochemicals present in it [95-96].

7.3 Antioxidants

In diabetes mellitus reactive oxygen species (ROS) normally founds in increased stage due to intracellular metabolism of glucose oxidation which constantly produce superoxide radicals (O2) and hydrogen peroxide ($_{H2O2}$). These free radicals generate hydroxyl radical for the acceleration of lipid peroxidation and decrease the activities of superoxide dismutase (SOD) and catalase (CAT) [97]. SOD reduces the toxic effects of superoxide radicals and CAT protects tissues from highly reactive hydroxyl radicals. Activities of these enzymes in diabetic brain increase after oral administration of aq. extract of seed and alcoholic extract help to restore them to normal level. Seed kernel plays a protective role due to the ant oxidative effect of highly present flavonoids in *S. cumini* acts as singlet oxygen quenchers and strong superoxide radical [98].

7.4 Hepatoprotective activity

Injury of liver due to exposure of exogenous and endogenous substances coupled with impaired liver function is hepatotoxicity. Oxidative stress and free radicals have important role to causes injury and plant materials having antioxidant activities are used to treat liver injury or hepatic stress. *S. cumini* and its different part such as, seeds, leaves and bark used as folklore to treat gastrointestinal and liver diseases and significant hepatoprotective effect was observed by aqueous extract of *S. cumini* seed in diabetic rats [99-101].

Fig. 1: Different parts of *Syzigium Cumini*

8. CONCLUSION

Thus, the medicinal plant *Syzygium cumini* is most widely used for various pharmacological actions. It is therefore worthwhile to undertake studies for head-to-head comparisons of these two extracts at similar dosages to arrive at the effective formulations.

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10. DISCLOSURE OF CONFLICT OF INTEREST

The author declares no conflict of interest.

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