Syzygium aqueum: From Traditional Fruit to Therapeutic Frontier

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Abstract:

***Syzygium aqueum*, commonly known as the water apple, is a tropical tree species recognized for its juicy, bell-shaped fruits and traditional medicinal uses. Belonging to the Myrtaceae family, it is native to Southeast Asia and thrives in warm, humid environments. The plant is widely cultivated not only for its refreshing fruit, which is high in water content and low in calories, but also for its therapeutic potential. Various parts of the plant—leaves, bark, and seeds—are traditionally used to treat a range of ailments, including infections, digestive issues, and skin conditions. Recent phytochemical studies have identified a diverse array of bioactive constituents such as flavonoids, tannins, and phenolics, which exhibit promising antioxidant, anti-inflammatory, and antimicrobial properties. As scientific interest in plant-based bioactives grows, *S. aqueum* emerges as a candidate for further research in food science, pharmacology, and sustainable agriculture. This abstract highlights the botanical features, nutritional value, ethnopharmacological relevance, and prospects of *Syzygium aqueum* as a versatile plant with both economic and medicinal importance.**

Key words: ***Syzygium aqueum, water apple, flavonoids, phenolics, antioxidant, ethnopharmacological relevance.***

Introduction:

People have historically employed medicinal plants to cure a wide range of illnesses. There are currently several medicinal plants that have been scientifically proven to aid people with various health issues *[1]*. Medicinal plant-based ingredients are crucial in the management of a greater number of illnesses.

The last several decades have seen a massive expansion in the field of herbal medicine. Several illnesses and physiological anomalies have been cured and treated with herbal remedies. As a result, natural items have long been a significant source of pharmaceuticals *[2]*.

Native to Indonesia and Malaysia, *Syzygium aqueum* Alston is a fruit-bearing plant in the Myrtaceae family. It's known as Jambu air in Indonesia. In traditional medicine, *S. aqueum* leaves, bark, roots, and other tissues have long been utilized (Cock and Cheesman 2018). It possesses antityrosinase, antioxidant anti-inflammatory, and antibacterial properties *[3]*.

Although it is susceptible to cold, the *S. aqueum* tree grows well in rich, heavy soils. With branching near the base, it reaches a height of 8–10 m. The oblong to elliptic leaves are 4.5 to 23 cm in length and 1.5 to 11 cm in width. The length of the leafstalk is 1–5 mm. The pinkish or yellowish-white flowers are 2-3 cm long. They formed axillary or terminal cymes, and the flowering *[4]*.

The objective of this review is to thoroughly describe *S. aqueum's* phytochemistry, traditional use, and pharmacological characteristics while highlighting its importance as a possible topic for future research.



Fig 1: *S. Aqueum* Plant



Fig 3: *S. Aqueum* Fruits



Fig 2: *S. Aqueum* Leaves



Fig 4: *S. Aqueum* Flowers

I. Plant Profile:

Scientific name: water apple, Java apple, water rose apple.

Kingdom: Plantae

Division: Tracheophyta

Class: Magnoliopsida

Order: Myrtales

Family: Myrtaceae

Genus: *Syzygium*

Species: *S.aqueum*

A. VERNACULAR NAMES:

- Hindi : Gulabjamun
- Gujarati : Gulabjamun
- Malayalam : Malakkacampa
- Kannada : Pannerale
- Telugu : Jambuneredu
- Marathi : Jamb
- Assamese : Golapi-jamuk
- Tamil : Champai
- English : Rose apple, malabar plum

II. Origin And Distribution Of *Syzygium Aqueum*:

The three countries where Syzygium aqueum is most common are Sri Lanka, Pakistan, and Malaysia. Up to 1500 meters in elevation, it is more likely to be found in damp deciduous forests in India. It grows well in warmer climates like Tamil Nadu, West Bengal, Punjab, Rajasthan, Kerala, Orissa, Maharashtra, Andhra Pradesh, Assam, and Karnataka. (Figure No. 5).

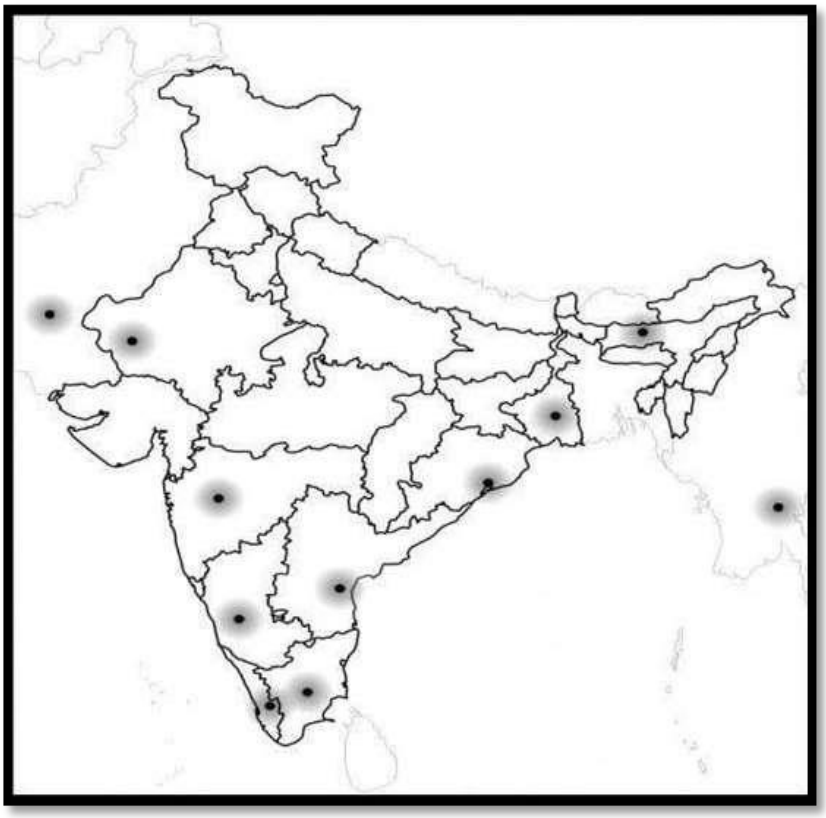


Figure No.5: Geographical distribution of *Syzygium aqueum* in several places

of Indian subcontinent

III. Composition Of Nutrition:

The watery rose apple's high-water content (around 90%) makes it a low-calorie fruit.

According to Monisha et al. (2018) *[20]*, the average chemical composition is calcium (29 mg), potassium (123 mg), and sulfur (13 mg). Iron (0.88 mg), phosphorus (1.14 mg), total fat (0.86 mg), and vitamin C (24.78 mg). Rose apples are rich in lipids (4.51 g), carbohydrates (59.25 g), protein (8.62 gm), and fiber (9.34 g per 100 gm). They also provide 300.54 mg of anthocyanins, 292.59 mg of vitamin C, and 312.07 kcal of calories. Augusta et al. (2010) *[21]*; Costa et al. (2006) *[22]*.

According to Nallakurumban et al. (2015). watery rose apples have the following nutritious composition.

Table No.1: The following table describes the nutrient composition of watery rose apple

as reported by Nallakurumban et al. 2015 *[23]*.

S. NO	CONSTITUENTS	RANGE
1.	Total phenolic contents (mg/100g)	28.80-30.70
2.	Total flavonoids (µg/g)	62.03-62.07
3.	Antioxidant activity (µg/g)	138.4-144.50
4.	Beta carotene(µg/g)	37.21-37.28
5.	Ascorbic acid /vitamin C contents (mg/100g)	13.06-13.08
6.	Moisture (g %)	91.70
7.	Protein	0.31
8.	Fat (g %)	0.29
9.	Ash (g %)	1.24
10.	Crude fibre (g %)	1.37
11.	Acidity (g %)	0.07
12.	TSS (bx)	5.4
13.	pH	4.14
14.	Calcium (mg)	0.64

IV. Phytochemical Constituents Of *S. Aqueum*:

Due to its wide range of pharmacological properties, *S. aqueum* is known to include a large number of nutraceuticals, which has prompted research into its chemical components. The leaves are the most heavily used component. Phenolic substances from several classes, including phenolic acids, flavonoids, anthocyanins, tannins, and lignans, are generally abundant in the plant. *S. aqueum* also contains volatile oils and terpenoids. Limited research has examined the fruits and stem bark, despite the fact that most studies have focused on separating and characterizing bioactive chemicals from the leaves. Like the leaves, the fruits have been shown to contain flavonoids and phenolic compounds, indicating that they may be used as a source of volatile chemicals and oils for medicinal, nutritional, and industrial uses *[5]*.

V. Health Benefits Of Water Apple *[6]*:

A. Fights Free Radical Damage:

Rose apples are high in vitamin C, which helps the body avoid the damage caused by free radicals, pollutants, and toxic chemicals that cause diseases like cancer, heart disease, and arthritis. Free radicals are created in the body when the body is exposed to radiation, tobacco, or smoke, as well as during the breakdown of food. Vitamin C also helps the body produce more white blood cells and aids in its smooth operation. Since vitamin C is an antioxidant, it prevents oxidative damage and improves the body's ability to function normally. Additionally, it is thought that vitamin C effectively strengthens the immune system to fight off colds.

B. Reduced Risk of Stroke:

Rose apples include vitamin C, which reduces the risk of stroke and other conditions like oxidative damage, inflammation, heart disease, atherosclerosis, high blood pressure, and endothelial health. The accumulation of plaque in the body can lead to heart attacks or strokes, which vitamin C can help prevent.

C. Prevent Diabetes:

The consumption of rose apples lowers blood glucose levels by increasing the activity of enzymes involved in the metabolism of carbohydrates, including glucose-6-phosphate dehydrogenase, hexokinase, and glucose-6-phosphatase, according to studies.

D. Boost Good HDL Cholesterol:

The vitamin Niacin, which is used to raise cholesterol, is found in rose apples. Triglycerides and LDL cholesterol are decreased by niacin, while HDL cholesterol is raised.

E. Prevent muscle cramping:

Rose apples provide a sufficient amount of potassium, which increases muscle strength and lessens cramping in the muscles caused by low potassium levels.

F. Prevent Constipation:

The dietary fiber in rose apples helps the digestive system transport materials and stimulates stools, which is beneficial for people who have constipation or irregular stools. It lowers the risk of heart disease and diabetes and promotes a healthy weight.

G. Skin Health:

Rose apples provide a sufficient amount of vitamins A and C, which aid to guard against oxidative stress brought on by pollution, stress, and diet deficiencies. Additionally, it minimizes wrinkles and skin dryness.

VI. Traditional Uses of *S. Aqueum*:

S. aqueum has been traditionally used for several medicinal purposes *[7]*. Fruits, leaves, and bark had numerous medicinal applications for curing fever, liver detoxification, headaches, skin disorders, and cancer prevention. In Malaysia, dried leaf powder is used to treat cracked tongues, while a root preparation is used to lessen swelling and itching *[8]*. It has been utilized for a number of phytotherapeutic purposes in tropical Asia *[9,10]*. In Indonesia, fermented sticky rice snacks are wrapped in leaves. Additionally, the fresh leaves are consumed raw to treat pneumonia and malaria, while the dried leaves are consumed with vegetables. The leaves are used as an infusion to treat dysentery and stomach aches. The leaves have been used to ease the discomfort of childbirth *[11]*. Oxidative medicine and cellular longevity thrush, which are brought on by Candida albicans and affect the oral cavity as well as other areas of the body, can be relieved by this bark decoction *[10]*. The bioactive substances, including phenolic acids, flavonoids, tannins, lignans, and stilbenes that are present in plant extracts, are linked to the effectiveness of a plant as a traditional medicine.

Leaves:

Antioxidant and anti-inflammatory: Rich in flavonoids and polyphenols.
Antibacterial & antifungal: Leaf extracts inhibit microbial growth.
Blood sugar regulation: Used in traditional medicine to manage diabetes.
Bark:
Astringent properties: Sometimes used to treat wounds or digestive issues.
Fruit:
Hydrating and cooling: Due to high water content.
Rich in vitamins: It contains vitamin C and other nutrients.

VII. Pharmacological Review:

A. Hyperglycemic Activity

It was first discovered that S. aqueum leaf extract exhibited significantly higher α-amylase and α-glucosidase activity than the currently prescribed medication, acarbose. Tests on its bioactive components showed that they were quite effective at inhibiting the enzymes that hydrolyze carbohydrates, with myricetin-3-O-rhamnoside being the most

effective. *S. aqueum* was found to have greater activity than the positive control quercetin when the extract's ability to inhibit aldol reductase and the production of AGE was assessed *[12]*.

B. Antioxidant Activity

Antioxidants are essential for scavenging free radicals, reducing oxidative stress, and strengthening defences against oxidative damage. Antioxidants are found naturally in a variety of plant-based substances. Eating foods high in phenolic and flavonoid components can improve health by providing antioxidant benefits. Studies conducted in vitro have shown that *S. aqueum* leaf extract has strong antioxidant qualities and protects human keratinocytes (HaCaT cells) from UVA damage *[13]*.

C. Cosmeceutical Activity

Leaf extracts from *S. aqueum* may be used as an ingredient in skin care products since they are not only antioxidants but also can inhibit tyrosinase and perhaps block UVB rays *[14]*.

D. Hepatoprotective Activity

We evaluated the extract's antioxidant activity *in vivo* to confirm the findings from cell culture and *in vitro* experiments. As a result, it was established that the extract prevented rats from becoming intoxicated by CCl4. The injection of CCl4 increased all indicators of liver injury. All liver indicators showed protective effects when the extract was administered to the rats before they were injected with CCl4. The extract (200 mg/kg b.w.) considerably decreased the increased levels of TB, TC, TG, ALT, and AST, and its effects were similar to those of silymarin, a conventional lignin from Silybum marianum. Additionally, in liver tissue homogenates, CCl4 injection markedly raised the MDA level while dramatically lowering the GSH and SOD levels. With the exception of MDA, the extract significantly returned their levels to the typical control range. A histopathologic analysis was then used to further demonstrate the hepatoprotection provided by the leaf extract. The extract shielded the liver from CCl4's harmful effects *[15]*.

E. Antimicrobial Activity

Antimicrobial agents are essential compounds that are mostly used to fight harmful bacteria, either by eradicating them or preventing their growth in order to protect cells. Three types of *S. aqueum* were used to make the ethanolic extract, which showed efficacy against the growth of S. aureus, B. subtilis, E. coli, and P. aeruginosa, but no inhibition against Aspergillus flavus and Saccharomyces cerevisiae *[16]*.

F. Anti-Inflammatory Activity

An anti-inflammatory is a chemical that acts on the central nervous system (CNS) to inhibit pain signals to the brain, so reducing pain and inflammation. The polyphenol-enriched *S. aqueum* leaf extract demonstrated encouraging anti-inflammatory properties, inhibiting LOX, COX-1, and COX-2 with a greater selectivity for COX-2 than the industry standards indomethacin and diclofenac. It also decreased the degree of erythrocyte lysis after incubation with a

hypotonic buffer solution *[17]*.

G. Antiproliferative Property

Syzygium fruit, namely water apple (*S. aqueum*), was tested for its antiproliferative qualities against two cancer-origin cell types: MCF-7 (hormone-dependent breast cancer cell line) and MDA-MB-231 (nonhormone-dependent breast cancer cell line). Through 24, 48, and 72 hours, the colorimetric MTT test was used to assess the antiproliferation properties of aqueous and methanolic extracts. For 24 and 48 hours, the results indicated that fruit extracts had no discernible effects; however, after 72 hours, the extracts revealed antiproliferation effects on MCF-7 cell lines, with no impacts on the non-cancer origin cell line *[18]*.

H. Anti trypanosomal

It was stated that North American plant extracts were screened in vitro against Trypanosoma brucei in order to find new antitrypanosomal medication leads. Eight plant extracts were found to be extremely effective antitrypanosomal extracts with IC50 values less than 1 µg/ml: Alnusrubra, Hoitamacrostachya, Sabal minor, Syzygium aqueum, Hamamelisvirginiana, Coccolobapubescens, Rhusintegrifolia, and Nupharluteum *[19]*.

I. Analgesic Activity

The analgesic properties of rose apples (*Syzygium aqueum*) have not been directly proven. But according to some research, there might be pain-relieving benefits. To examine and validate rose apples' analgesic properties, pinpoint the chemicals causing these effects, and understand how they work to relieve pain in humans, more comprehensive research including clinical trials is needed. Always consult a healthcare professional before beginning any pain management procedures or treatments *[24]*.

VIII. Conclusion

Syzygium aqueum has a broad range of biological actions, including anti-inflammatory, anti-microbial, antidiabetic, antioxidant, and anticancer qualities, according to the pharmacological review. Because of these properties, it is a good candidate for additional study and the creation of medicinal substances. Nevertheless, additional clinical research and toxicological evaluations are required to completely comprehend its safety profile and effectiveness in applications related to human health.

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