

OVERVIEW OF PHYTOCHEMISTRY AND PHARMACOLOGY OF SYZYGIUM AQUEUM

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ABSTRACT

In the last few decades there has been an exponential growth in the field of herbal medicine. Herbal medicines have been the basis of treatment and cure for various diseases and physiological conditions in traditional methods of practice such as Ayurveda, Unani and Siddha. Medicinal components from plants play an important role in conventional as well as western medicine. They were the sole source of active principles capable of curing man's ailments. Thus natural products have been a major source of drugs for centuries. *Syzygium aqueum*, commonly called „water apple“ belonging to the family Myrtaceae is a tropical, evergreen and low growing small tree. *Syzygium aqueum*, consisting of various fruit colors, is one of the plants that have been used as traditional medicine. The present review is an attempt to highlight the various ethnobotanical and traditional uses as well as phytochemical and pharmacological reports on *Syzygium aqueum*.

KEYWORDS: *Syzygium aqueum*, Bell fruit, Antioxidant, Chemical constituents.

1. INTRODUCTION

Medicinal plants are considered as an upscale resources of ingredients which may be utilized in drug development either pharmacopoeial, non-pharmacopoeial or synthetic drugs. A neighborhood from that, these plants play a critical role within the development of human cultures round the whole world. Moreover, some plants are considered as important source of nutrition and as a results of that they are recommended for his or her therapeutic values. The good interest within the use and importance of medicinal plants in many countries has led to intensified efforts on

the documentation of ethnomedicinal data of medicinal plants.^[1] *S. Aqueum*, commonly referred to as water apple, one among the foremost valuable medicinal plant species under the Myetaceae. In Ayurveda, the plant extract has been evidenced to be pharmaceutically active as anti hyperglycaemic activity, anti inflammatory activity, Anti oxidant activity ect. The medicinal activities of this genus are such a lot vigorous that a broader range of study is required to be completing to assess the whole pharmacological role in various ailments.



Fig: 1 Leaves of *Syzygium aqueum*



Fig: 2 Flowers of *Syzygium aqueum*



Fig: 3 Fruits of *Syzygium aqueum*.

2. VERNACULAR NAMES

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

3. TAXONOMY

- Kingdom : Plantae
- Clade : Tracheophytes
- Clade : Angiosperms

- Clade : Eudicots
- Clade : Rosids
- Order : Myrtales
- Family : Myrtaceae
- Genus : Syzygium
- Species : *S. aqueum*

4. DISTRIBUTION

Syzygium aqueum particularly distributed in Sri Lanka, Pakistan and Malaysia, In India, it is most likely to occur in moist deciduous forests up to an altitude of 1500 m. It generally grows in the warmer parts like Andhra Pradesh, Assam, Karnataka, Kerala, Orissa, Maharashtra, West Bengal, Punjab, Rajasthan and Tamilnadu,. (Fig 4).

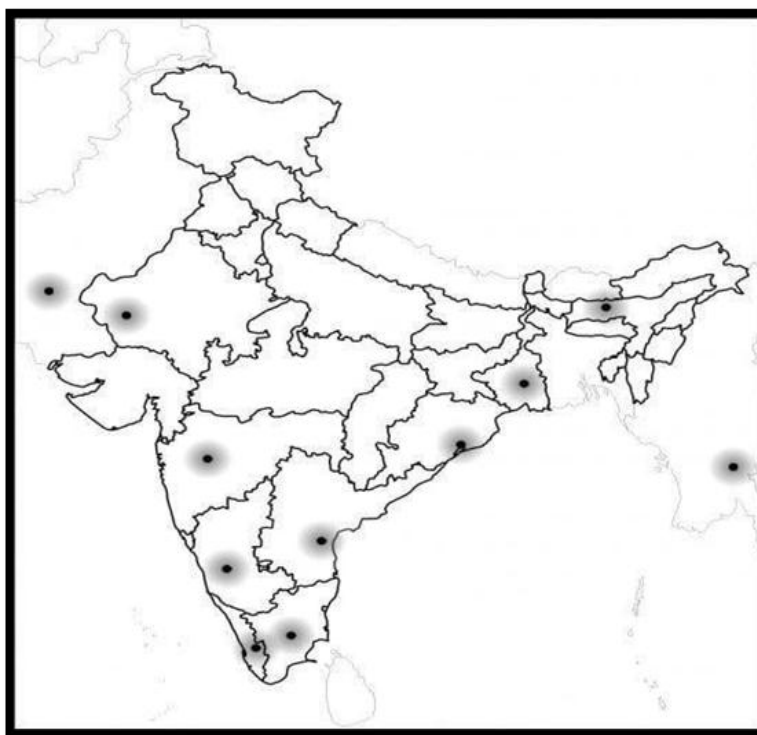


Fig 4: Geographical distribution of *Syzygiumaqueum* in several places of Indian subcontinent.

5. Botanical Description

Macroscopical characters

The tree of *Syzygium aqueum* is cultivated well in heavy and fertile soils and is sensitive to frost. It grows up to a height of 8–10 m with branching near the base. Leaves are 4.5–23 cm long, 1.5–11 cm wide and oblong to elliptic. The leafstalk is 1–5 mm long. Flowers are yellowish-white or pinkish and are 2–3 cm long. They produced terminal or axillary cymes and moreover the flowering season occurs in February–March and fruits mature during May–June. Fruits are pale rose or white. They are watery, small bell-shaped with shining skin, spongy and slightly fragrant. They are about 1 inch long and are ½ inch wide.

6. MEDICINAL USES

Various part of this plant are used in traditional medicine; while the leaves has been shown to have antibiotic activity and relieving child birth pains. The dried leaves in powdered form have been used to treat mouth ulcers and a preparation of its root have been used to relieve itching and reduce swelling. A decoction of the *Syzygium aqueum* astringent bark is used for thrush. The leaf extract has also been reported to have cosmeceutical properties, anti-tyrosinase, anticellulite and lypolitic.

Health Benefits of Water Apple^[10]

1. Fights Free Radical Damage: Rose Apple is rich in Vitamin C. It prevents the damage of free radicals, pollutants and toxic chemicals which leads to the health ailments such as heart disease, cancer and arthritis. Free radicals are developed in the body when the body is exposed to the radiation, tobacco or smoke and during the process of breaking down of food. Vitamin C enhances the white blood cells production and also assists in the functioning. As Vitamin C is an antioxidant, it eliminates the oxidative damage and enhances the smooth functioning. It is also believed that

Vitamin C effectively boosts the immune system to counteract the colds.

2. Reduced Risk of Stroke: The presence of Vitamin C in the Rose Apples lowers the chances of stroke and health ailments such as inflammation, oxidative damage, cardiac health, atherosclerosis, blood pressure and endothelial health. The development of plaque in the body results in the stroke or heart attack which could be reduced with the Vitamin C.

3. Boost good HDL Cholesterol: Rose Apple is the source of Niacin which is used to add cholesterol. Niacin enhances the HDL cholesterol levels and reduces the triglycerides and LDL cholesterol

4. Prevent Diabetes: The research has shown that the use of Rose Apple reduces the level of blood glucose by enhancing the activities of carbohydrate metabolic enzymes such as glucose-6-phosphate dehydrogenase, hexokinase and glucose-6-phosphatase.

5. Prevent Constipation: Dietary fiber in Rose Apple supports the digestive system in the material movement and stimulate stool which is helpful for those having the irregular stools or constipation. It supports in healthy weight and reduces the chances of heart disease and diabetes.

6. Prevent muscle cramping: Rose Apple possess adequate amount of potassium. It enhances the strength of muscles and reduces the muscle cramps which is due to the low level of potassium.

7. Skin Health: An adequate amount of Vitamin A and C could be obtained from the Rose Apple which helps to prevent the damage from the oxidative stress caused from the poor diet, stress and pollution. It also reduces the dryness of the skin and reduces the wrinkles.

7. Phytochemistry

The plant contains different functional group such as flavonoids,^[11] anthocyanidins,^[12] phenolic compounds and terpenoids.^[13, 14] A brief is presented in Table below.

Different active components of *Syzygium aqueum*.

ACTIVE COMPONENTS		PARTS
Proanthocyanidins	Samarangenins A and B	Leaves
Flavonoids	4-hydroxybenzaldehyde, myricetin- 3-O-rhamnoside, europetin-3-O- rhamnoside, phloretin, myrigalone-G myrigalone-B	Leaves
Terpenoids	α -Selinene (13.85%), β - caryophyllene (12.72%) β -selinene	Leaves
	γ -terpinene	Fruits

Volatile Constituents: The volatile constituents of five fruits from four *Syzygium* species from Malaysia were isolated by vacuum distillation with subsequent dichloromethane extraction. The concentrated extracts were analysed by capillary GC and GC-MS. A total of 42, 39, 36 and 41 constituents were identified in water apple (*S. aqueum* Alston). In roseapple volatiles about 60% 3-Phenylpropan-1-ol, (E)-cinnamyl alcohol and other compounds with the C6-C3 skeleton were constituted but were absent among the volatiles of the

other *Syzygium* fruits. Water apple yielded the largest number and proportion (41.4%) of terpenoids, among which γ -terpinene was clearly dominant.^[14]

8. Pharmacology

Acute and Sub chronic Toxicity: The acute and sub chronic toxicity effects of the *Syzygium aqueum* leaves were evaluated. For this acute toxicity study 2000mg/kg of the *S. aqueum* leaves were given orally to male rats (Sprague -Dawley) and for 14 days and they were

observed for toxicity and mortality. In sub chronic toxicity study *Syzygium aqueum* leaves were given orally at different doses like 50, 100, and 200mg/kg for 28 days. In both acute and subchronic toxicity the data clearly shows flavonoids and steroids. The fruits there were no acute or sub chronic toxicity observed.^[22]

Antimicrobial Activity: The histochemical test, phytochemical analysis and antimicrobial activity against Gram negative bacteria *Escherichia coli*, *Pseudomonas aeruginosa*; Gram positive bacteria *Staphylococcus aureus*, *Bacillus subtilis*; and fungi *Aspergillus flavus* and *Saccharomyces cerevisiae* were done in the collected fruits and leaves. The screening of bioactive components indicates the presence of alkaloid, tannins, glycosides, formic acid, tartaric acid, flavanoid leaves of ethanolic extract of the three varieties of *S. aqueum* showed to be effective against the growth of *S. aureus*, *B. subtilis*, *E. coli* and *P. aeruginosa* and there is no inhibition observed against *Aspergillus flavus*, *Saccharomyces cerevisiae*.^[15]

Antiproliferative Property: The antiproliferative properties of *Syzygium* fruits, namely water apple (*Syzygium aqueum*), milk apple (*Syzygium malaccense*) and malay apple (*Syzygium malaccense L.*) against two types of cancer-origin cells, namely MCF-7 (hormone dependent breast cancer cell line) and MDA-MB-231 (nonhormone-dependent breast cancer cell line) were investigated. Antiproliferation activities of aqueous and methanolic extracts were evaluated by colorimetric MTT assay through time periods of 24, 48, and 72 hours. The result showed that extracts from the three fruits had no significant effects for 24 and 48 hour time periods but extracts of Water apple and Malay apple displayed antiproliferation effects on MCF-7 cell lines in 72 hours, also there were no effects on the non-cancer origin cell line. The methanolic extracts of the malay apple was more significant with 79% cell viability in the case of MCF7. This finding revealed that fruits extract exhibit antiproliferative activity against MCF-7.^[16]

Antioxidant Activity: The antioxidant activity and phytochemical contents in ten underutilized fruits of Andaman Islands (India) namely *Malpighia glabra L.*, *Mangifera andamanica L.*, *Morindacitrifolia L.*, *Syzygium aqueum* (Burm.f) Alst, *Annonasquamosa L.*, *Averrhoa carambola L.*, *Averrhoa bilimbi L.*, *Dillenia indica L.*, *Annona muricata L.* and *Ficus racemosa L.* were studied. The antioxidant activity varied from 74.27% to 98.77%.^[17] The antioxidant activity of fresh and dried plants extract of *Paederia foetida* and *Syzygium aqueum* were studied using β -carotene bleaching and the 2,2'-azinobis(3-ethyl-benzothiazoline-6-sulfonic acid) (ABTS) radical cation assay. The percentage antioxidant activity for all extract of samples was between 58 and 80%. The fresh samples of both plants had higher antioxidant activity than the dried samples.^[18] The Prooxidant/Antioxidant capacity of *Nephelium lappaceum* peel, *Fragaria x ananassa* leaf, *Lawsonia inermis* leaf, *Syzygium aqueum* leaf were

analysed. *Syzygium aqueum* leaf has low pro oxidant activity but high DPPH scavenging activity.^[19]

Diabetes Mellitus: The insulin-like and/or insulin-sensitising effects of *Syzygium aqueum* leaf extract were studied. Its six bioactive compounds are 4-hydroxybenzaldehyde, myricetin-3-O-rhamnoside, europetin-3-O-rhamnoside, phloretin, myricetin-3-O-rhamnoside-G and myricetin-3-O-rhamnoside-B were investigated in 3T3-L1 adipocytes. *S. aqueum* leaf extract (0.04–5 μ g/ml) and its six bioactive compounds (0.08–10 μ M) at non-cytotoxic concentrations were effectively enhance adipogenesis, stimulate glucose uptake and increase adiponectin secretion in 3T3-L1 adipocytes. Clearly, the compounds myricetin-3-O-rhamnoside and europetin-3-O-rhamnoside showed insulin-like and insulin-sensitising effects on adipocytes from a concentration of 0.08 μ M. These compounds were far better than rosiglitazone and the other isolated compounds in enhancing adipogenesis, stimulating 2-NBDG uptake and increasing adiponectin secretion at all the concentrations tested. These suggest the antidiabetic potential of *S. aqueum* leaf extract and its six bioactive compounds.^[20]

Free Radicals: The leaf extracts of were reported to have a significant composition of phenolic compounds, protective activity against free radicals as well as low pro-oxidant capability. The extract displayed other activities, deeming it an ideal cosmetic ingredient. A substantial tyrosinase inhibition activity with an IC₅₀ of about 60 μ g/mL was observed. In addition, the extract was also found to have anti-cellulite activity tested for its ability to cause 98% activation of lipolysis of adipocytes (fat cells) a concentration of 25 μ g/mL. Therefore, the use of this extract, alone or in combination with other active principles, is of interest to the cosmetic industry.^[5]

Antitrypanosomal: The Screening North American plant extracts in vitro against *Trypanosoma brucei* for discovery of new antitrypanosomal drug leads were reported. Eight plants extracts namely, *Alnus rubra*, *Hoitamacrostachya*, *Sabal minor*, *Syzygium aqueum*, *Hamamelis virginiana*, *Coccolobapubescens*, *Rhus integrifolia* and *Nuphar luteum* were identified as highly potent antitrypanosomal extracts with IC₅₀ values <1 μ g/ml.^[22]

Anticancer activity: *S. aqueum* leaves were extracted with methanol for the determination of cytotoxicity using sulforhodamine B (SRB) assay. The activity was tested on human breast cancer cell (MDA-MB-231) and compared with that of doxorubicin (standard cytotoxic drug). The extract was less toxic on cancer cell line (IC₅₀ > 100 μ g/mL).

Anti-inflammatory activity: The anti-inflammatory activity of the methanolic extract of *S. aqueum* leaves was determined. For this study, the ability of the extract to inhibit lipoxygenase (LOX) using an LOX inhibitor screening assay kit was established as well as ovine

COX-1 and COX-2 inhibition using an enzyme immunoassay kit. Celecoxib, indomethacin and diclofenac were used as standards. The extract showed more potent inhibitory effect than diclofenac on COX-2 as well as on LOX. Celecoxib was less active than the extract on COX-1.

9. CONCLUSION

Syzygium aqueum have found its use in traditional medicine across different regions of the planet. Various pharmacological activities and presence of the many bioactive compounds are confirmed by studies though many of them are yet to be quantified. Counting on its phytotherapeutical importance, research for identification of the many new secondary metabolites is required because the plant carries huge potential as a longtime medicinal plant but not yet exploited to its maximum. *Syzygium aqueum* is widely discussed but its clinical studies have yet not been undertaken. Hence, within the near future, clinical evaluation should form a benchmark for safe therapeutic applications of this species. This review has presented the general properties, important chemical constituents and traditional uses along with the wide range of pharmacological activities of *Syzygium aqueum* which will be helpful to the researchers for further study about the plant.

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