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Review Article

Syzygium aqueum: A Comprehensive and Phytochemistry and Phytoscreening Study of Plant Review

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ABSTRACT

Syzygium aqueum, commonly known as water apple, is a tropical fruit tree extensively cultivated in Southeast Asia and other humid tropical regions. In addition to its horticultural value, the species has gained increasing scientific attention due to its nutritional benefits, phytochemical diversity, and wide range of ethnomedicinal uses. The fruit is rich in water, dietary fiber, vitamins, and essential minerals, making it a refreshing and health-promoting food. Traditionally, various parts of the plant, including leaves, bark, and roots, have been used in folk medicine to treat inflammation, diabetes, gastrointestinal disorders, and microbial infections. Phytochemical studies have revealed the presence of bioactive compounds such as flavonoids, tannins, phenolic acids, and triterpenoids, which are responsible for its antioxidant, antimicrobial, anti-inflammatory, and antidiabetic activities. Pharmacological investigations further support these traditional claims, highlighting the therapeutic potential of S. aqueum. Ecologically, the species plays an important role in agroforestry systems by providing shade, improving soil stability, and supporting biodiversity. Despite its promising attributes, challenges remain in improving cultivation techniques, ensuring consistent phytochemical profiles, and standardizing pharmacological evaluations. This review summarizes current knowledge on the botany, phytochemistry, pharmacology, and ecological significance of S. aqueum, emphasizing its potential as a multipurpose plant for sustainable agriculture and future drug discovery.

INTRODUCTION

Syzygium aqueum, commonly known as watery rose apple or water apple, is a tropical fruit tree of the family Myrtaceae, prized for its juicy, bell-shaped fruits and medicinal properties. Widely cultivated across Southeast Asia and other humid regions, this species has gained scientific attention due to its nutritional value, phytochemical richness, and diverse ethnomedicinal uses. The fruit is valued for its high water content, dietary fiber, and essential micronutrients, while the

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leaves, bark, and roots have traditionally been used to manage inflammation, diabetes, and microbial infections. Phytochemical studies have identified bioactive compounds, including flavonoids, tannins, and phenolic acids, which contribute to its antioxidant, antimicrobial, and anti-inflammatory activities. Additionally, S. aqueum plays an important ecological role in agroforestry systems, providing shade, stabilizing soil, and supporting biodiversity. Despite these benefits, challenges remain in optimizing cultivation, standardizing pharmacological assessments, and developing commercial applications. This review summarizes current knowledge on the botany, phytochemistry, pharmacology, and ecological significance of S. aqueum, highlighting its potential as a multipurpose species for sustainable agriculture and future drug discovery.

Humans have relied on medicinal plants since ancient times for the treatment of various diseases. In recent years, many medicinal plants have been scientifically validated for their role in managing and preventing numerous health problems[1]. Plant-derived bioactive compounds are essential in disease treatment and in maintaining normal physiological functions. Medicinal plants are valuable not only for curing diseases but also for promoting overall health and well-being[2].

Herbal medicine has expanded rapidly over the past few decades, with many diseases and physiological disorders being treated using plant-based remedies. As a result, natural products have remained a major source of therapeutic drugs for centuries[3]. The Myrtaceae family ranks as the eighth-largest family of medicinal plants, comprising approximately 140 genera and 3,800–5,800 species. Among these, Syzygium is one of the largest flowering plant genera in the family and is widely cultivated for its colourful and fleshy fruits[4].

The plant shows many biological activities and has long been used in traditional medicine. Fresh leaves are eaten to reduce childbirth pain, while powdered dried leaves are applied to treat mouth ulcers. The fruit is commonly used for liver-related problems. Bark decoctions are used to treat thrush, and root preparations help relieve itching and swelling. These medicinal effects of S. aqueum are mainly due to the presence of polyphenols, flavonoids, tannins, steroids, and volatile oils. The plant also contains important nutrients such as iron, calcium, vitamins, and antioxidants. Several studies have reported the biological activities of different parts of S. aqueum.

Syzygium aqueum (S. aqueum), commonly known as water apple, is one of the most important medicinal plant species in the Myrtaceae family[5]. Its fruits are widely preferred, and the plant is easy to cultivate. It is commonly grown in home gardens for its edible fruits as well as for shade and protection. Native to Indonesia and Malaysia, the fruit is popularly called water jambool. It is also known by other common names such as water apple, bell fruit, water cherry, and watery rose apple[6].

Syzygium aqueum (S. aqueum) is rich in bioactive compounds found in different parts of the plant, including phenolic compounds, flavonoids, tannins, terpenoids, and essential oils[7]. The plant has been widely used in traditional medicine and is reported to possess various biological activities. Its fruit is commonly used to treat liver disorders, while fresh leaves are consumed to relieve childbirth pain, and dried leaf powder is applied to treat mouth ulcers. Root preparations are used to reduce itching and swelling, whereas bark decoctions are used for treating thrush[8]. Different parts of the plant have been reported to exhibit antioxidant, anti-inflammatory, hepatoprotective, and antinociceptive activities[9]. This review aims to

provide a comprehensive overview of the phytochemical profile, nutritional composition, traditional uses, and pharmacological properties of S. aqueum, highlighting its potential for future research.






Taxonomical Classification:

Syzygium aqueum, commonly known as watery rose apple, belongs to the following taxonomic classification[10]:

Taxonomic Classification of *Syzygium aqueum*

Botanical name	***Syzygium aqueum***
Family	Myrtaceae
Kingdom	Plantae
Subkingdom	Viridiplantae
Class	Magnoliopsida
Division	Tracheophyla
Subdivision	Spermatophyta
Order	Myrtales
Superorder	Rosanae
Genus	Syzygium
Species	*S. aqueum* (Burm, f) Alston

Synonyms

Cerocarpus aqueus Hassk., Eugenia alba Roxb., Eugenia aquea Burm. f., Eugenia callophylla (Miq.) Reinw. ex de Vriese, Eugenia malaccensis Lour. nom. illeg., Eugenia mindanaensis C.B. Robinson, Eugenia nodiflora Aubl., Eugenia observa Miq., Eugenia stipularis (Blume) Miq., Gelpkea stipularis Blume, Jambosa alba (Roxb.) G.Don, Jambosa ambigua Blume, Jambosa aquea (Burm. f.) DC., Jambosa calophylla Miq., Jambosa madagascariensis Blume, Jambosa obtusissima (Blume) DC., Jambosa subsessilis Miq., Jambosa timorensis Blume, Malidra aquea Raf., Myrtus obtusissima Blume, Myrtus timorensis Zipp. ex Span., Syzygium obversum (Miq.) Masam.11

VERNACULAR NAMES:

- **Hindi:** Gulabjamun
- **Gujarati:** Gulabjamun

- **Malayalam:** Malakkacampa
- **Kannada:** Pannerale
- **Telugu:** Jambuneredu
- **Marathi:** Jamb
- **Assamese:** Golapi-jamuk
- **Tamil:** Champai
- **English:** Rose apple, Malabar plum

Botanical Description:

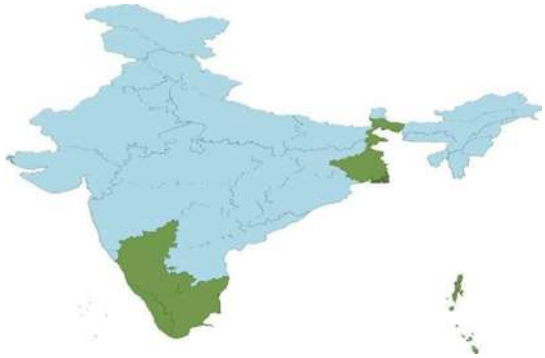
Watery rose apple is a tropical fruit tree that grows best at temperatures between 25–32 °C, which support better growth, higher yield, and improved fruit quality. Although deep loamy soil is considered ideal, the plant can also grow well in sandy and limestone soils with low organic matter. A continuous water supply is ess moisture for healthy growth. Depending on the variety, the tree begins to bear fruit within 2–5 years after planting[13].

Syzygium aqueum grows well in heavy, fertile soils and is sensitive to frost. The tree reaches a height of about 8–10 m and shows branching near the base. Leaves are oblong to elliptic, measuring 4.5–23 cm in length and 1.5–11 cm in width, with a leaf stalk of 1–5 mm. The flowers are yellowish-white to pink, about 2–3 cm long, and are borne in terminal or axillary cymes, usually appearing from February onward. 14. Two main types of S. aqueum are commonly found: one with white fruits and the other with red or pale rose- coloured fruits. The plant can be propagated using seeds, budding, and air-layering techniques. The fruit pulp is crisp and watery in texture. The wood is hard and is often used for making handicrafts. Leaves are consumed either fresh or dried. Unripe green fruits are eaten raw and are also processed into pickles, jelly, syrup, and sauces. In Malaysia and Indonesia, watery rose apple fruits are commonly included in fruit salads[15].

Geographical Distribution:

Syzygium aqueum originates from tropical Asia and extends to northern Queensland. It is widely cultivated in India, Southeast Asia, and the Pacific Islands. In the Philippines, the plant grows abundantly in regions such as Mindanao, Basilan, Dinagat, and Samar, where it often appears to grow naturally in the wild[11]. It is also occasionally cultivated in Trinidad and Hawaii. The species is well distributed in Sri Lanka, Pakistan, and Malaysia.

In India, S. aqueum is commonly found in moist deciduous forests up to an altitude of 1,500 m. It grows mainly in warmer regions, including Andhra Pradesh, Assam, Karnataka, Kerala, Odisha, Maharashtra, West Bengal, Punjab, Rajasthan, and Tamil Nadu. The plant is also cultivated across South and Southeast Asia, including the Philippines, Myanmar, and Afghanistan[12].



Traditional Uses:

Syzygium aqueum is considered a promising plant in traditional medicine, particularly as a natural source of antioxidants[6]. The fruits, leaves, and bark of the watery rose apple are widely used in traditional practices to treat various conditions

such as fever, liver disorders, headaches, digestive problems, diabetes, high cholesterol, and skin diseases, and they may also help in cancer prevention. A decoction prepared from the astringent bark is commonly applied locally to treat thrush[15]. Literature reports indicate that different parts of S. aqueum are extensively used in Malaysian traditional medicine. The leaves are known to exhibit antibiotic activity, and tribal communities in Malaysia traditionally consume raw leaves to relieve childbirth pain. *Syzygium aqueum* has been reported to exhibit antityrosinase, lipolytic, and anticellulite activities. Literature studies also indicate that its leaves possess anticancer and antidiabetic properties[19]. According to traditional Chinese medicine, the leaves, fruits, and seeds of watery rose apple have antipyretic effects, while the roots act as diuretics. Consumption of wax apple fruit during hot summer conditions is considered effective in quenching thirst, relieving sunstroke, and reducing dehydration-related effects, highlighting its role in alleviating summer heat. Salted fruits are traditionally used to ease intestinal and stomach discomfort. The flowers of watery rose apple are astringent and are commonly used in the treatment of diarrhea and dysentery.

Ayurvedic / Traditional Uses of *Syzygium aqueum*

1. Digestive health

- Fruit is considered light (laghu) and cooling (śīta)
- Traditionally used for:
  - Mild indigestion
  - Acidity and gastritis
  - Thirst and dehydration in hot weather

2. Pitta pacifying

- Because of its cooling nature, it is used to reduce excess Pitta
- Helpful in:
  - Burning sensation
  - Excess body heat
  - Heat-related fatigue

3. Anti-diarrheal (folk use)

- Leaves and bark decoction are traditionally used for:
  - Diarrhea
  - Dysentery

Similar use pattern to *Syzygium cumini* (Jamun) though milder

4. Anti-inflammatory wound care

- Leaf paste applied externally in folk medicine for:
  - Minor skin inflammation
  - Small wounds and ulcers

5. Diabetes support (traditional, mild)

- Leaves have been used traditionally to help support blood sugar balance, but:
  - This use is much weaker and less studied than Jamun (*Syzygium cumini*)
  - Should not replace diabetes medication

6. Hydration s general nourishment

- Fruit pulp used as:

- A natural coolant
- Mild nutritive tonic in summer

Ayurvedic Properties (Traditional View)

- **Rasa (taste):** Madhura (sweet), slightly Kashaya (astringent)
- **Virya (potency):** Śīta (cooling)
- **Effect on Doshas:**
- ↓ Pitta
- Mildly ↓ Kapha
- Neutral to Vata (in moderation)

Parts used

- Fruit (fresh)
- Leaves
- Bark (less commonly)

Caution

- Excess intake may cause:
- Cold, cough, or digestive sluggishness, especially in Kapha-dominant individuals
- Not a substitute for prescribed treatment in chronic diseases

Morphological Characteristics:

Syzygium aqueum is a flowering plant species belonging to the Myrtaceae family and is commonly known as water apple or wax apple. This tropical tree is widely cultivated for its nutritious fruits, which are valued for their health-promoting and medicinal properties.

Morphological Features:

1. Tree: *Syzygium aqueum* is a medium-sized tree with a straight trunk and a broad, spreading crown that can reach a height of 12 meters.

2. Leaves: The elliptical, simple, opposite leaves have a wavy margin and a pointed tip. They have a glossy texture and are dark green in colour.

3. Flowers: Clusters of tiny, fragrant, white flowers are carried at the tips of branches

4. Fruit: A berry with a single seed in the middle is the fruit, which is usually conical or bell-shaped. The fruit has a sweet, slightly crunchy texture and can be either green or red, depending on the variety.

5. Roots: *Syzygium aqueum* has spreading, fibrous roots, including a deep taproot that aids in the tree's soil anchoring.

Other Qualities:

- **Bark:** The smooth, grayish-brown bark of Syzygium aqueum has a slightly rough
- **Wood:** The tree's wood is strong and resilient, and it's frequently used to make furniture and other wood goods
- **Leaves** of Syzygium aqueum are best dried in **shade** to preserve antioxidants.
- **Fruits** benefit from oven drying or solar dryers to retain flavor and nutrients.
- **Roots and stems** can tolerate sun or oven drying.
- Proper storage in airtight containers is critical to prevent moisture absorption microbial growth.

MATERIALS AND METHODS

Sample Collection and Extract Preparation

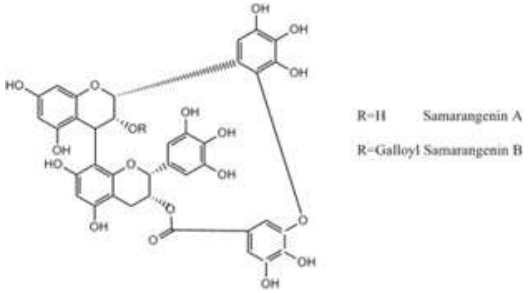
Fresh fruit samples of S. aqueum (Burm. f.) Alston were collected from the besgarhalli mandya district maddur taluk karnataka . The samples were washed with distilled water, sliced into small pieces, and air-dried. The air-dried samples were then ground using commercial grinders to obtain a fine powder. For extraction preparation, approximately 50 g of powdered sample was mixed with 200 ml of distilled water and placed in an orbital shaker at 110 rpm for 24 h at 25 ± 2°C. The samples were then centrifuged at 8000 rpm for 10 min, and the resulting supernatant was filtered through Whatman No. 1 filter paper. The crude extract was oven-dried at room temperature to obtain a powdery residue. The powdered crude extract was then extracted using different solvents (Distilled Water: E1; Acetone: E2; Ethanol: E3) for further studies.

Phytochemical Constituents:

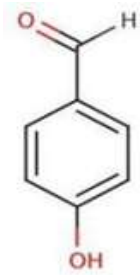
Due to its wide range of pharmacological effects, *Syzygium aqueum* is recognized as a rich source of nutraceutical compounds. This has encouraged studies on its chemical composition, with most research focusing on the leaves, which are the most commonly used plant part. Overall, the plant contains abundant phenolic compounds, including phenolic acids, flavonoids, anthocyanins, tannins, and lignans. In addition, S. aqueum also contains terpenoids and volatile oils. While most studies have emphasized the isolation and identification of bioactive compounds from the leaves, comparatively fewer investigations have examined the fruits and stem bark. Similar to the leaves, the fruits are rich in phenolics and flavonoids, indicating their potential as sources of volatile compounds and oils for industrial, nutritional, and pharmaceutical applications.

Different active componets of *Syzygium aqueum*

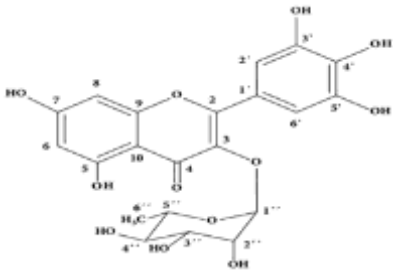
Active componets		Parts
Proathocyanidins	Samarangenins A and B	leaves
Flovonids	4- hydroxy benzaldehyde, myricetin-3-o-rhamnoside, europetin-3-o-rhamnoside, phloretin, myrigalone- G, myrigalone-B	Leaves
Terpenoids	Alpha-selinene (13.85%) Beta-caryophyllene (12.72%) Beta –selinene	Leaves
	Gama-terpinene	Fruits



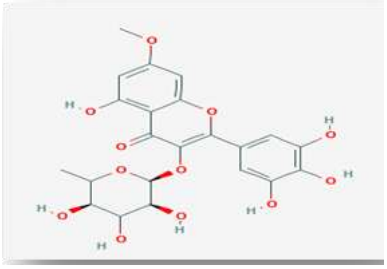
Samarangenins A and B



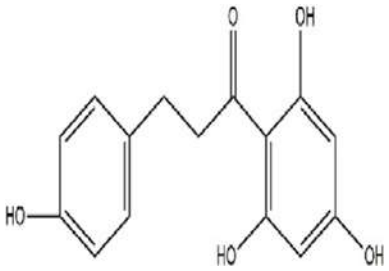
4 hydroxy benzaldehyde



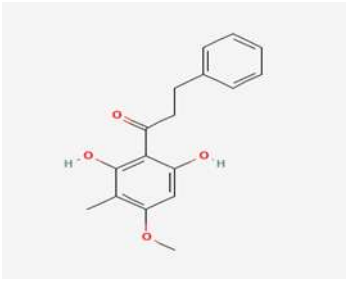
myricetin-3-o-rhamnoside,



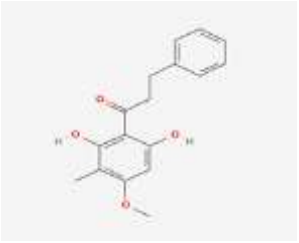
europetin-3-o-rhamnoside



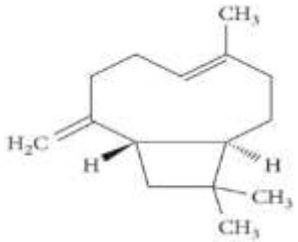
Phloretin



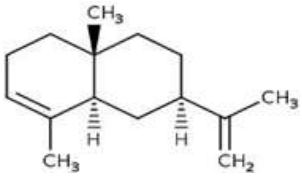
myrigalone-B



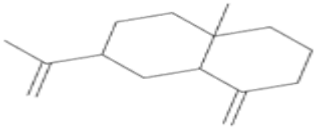
Myrigalone – G



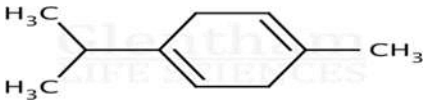
Beta-caryophyllene



Alpha-selinene



Beta –selinene



Gama-terpinene

Flavonoids: Methanol extract of S. aqueum leaves contained a number of 87 different compounds rich in flavonoids, for example, myricetin rhamnoside, myrigalone G pentoside, quercetin galloyl- pentoside, cryptostrobin, in which myrigalone- B and myrigalone- G were the major flavonoid compounds. Six flavonoids (e.g., 4-hydroxybenzaldehyde, myricetin- 3- O-rhamnoside, europetin- 3- O- rhamnoside, phloretin, myrigalone- G, and myrigalone- B) were isolated from the ethanol leaf extracts of S. aqueum. Among them, myricetin- 3- O-rhamnoside and europetin- 3- O- rhamnoside showed antihyperglycemic activity.

Phenols: Methanolic extracts of *Syzygium aqueum* leaves have been reported to contain several phenolic compounds, including caffeic acid[9].

Tannins: Methanol extract of S. aqueum leaves contained few number of tannin compounds (e.g. galloylquinic acid).

Proantrocyanins: Methanolic extracts of *Syzygium aqueum* leaves were analyzed using high-resolution LC-ESI-MS/MS, revealing 87 different compounds. The major proanthocyanins identified included samarangenin A, (epi)-gallocatechin gallate, and (epi)-catechin-(epi)-gallocatechin.

Nutritional Value: The fruit of the watery rose apple is rich in fiber, calcium, magnesium, potassium, and vitamin C, but contains very little protein. It also has high antioxidant activity and beta-carotene content. Due to its high water content and very low fat levels, it is a low-calorie fruit[15]. The nutrient composition of water apple per 100 g of edible portion has been reported by Dignan et al. (1994)[16].

Sr. No.	Constituent	Range / Amount
1	Moisture	95%
2	Protein	0.8 g
3	Fat	0.1 g
4	Carbohydrate	3 g
5	Fibre	1.3 g
6	Ash	0.7 g
7	Calcium	2 mg
8	Phosphorous	13 mg
9	Ferrous (Iron)	0.2 mg
10	Sodium	1 mg
11	Potassium	48 mg
12	Vitamin A	1 mg
13	Beta carotene	7 mg
14	Thiamine (B1)	0.044 mg
15	Vitamin C	16.7 mg
16	Vitamin E	Trace amount

Another analysis of water-apple fruit reported per 100 g of edible portion conducted in Malaysia by Tee et al. (1997) 17 is reported as:

Sr. No.	Constituent	Range / Amount
1	Energy	17 Kcal
2	Protein	0.8 g
3	Fat	0.1 g
4	Carbohydrate	3.1 g
5	Fibre	0.8 g
6	Ash	0.2 g
7	Calcium	2 mg
8	Phosphorous	5 mg
9	Iron	0.2 mg
10	Sodium	1 mg
11	Potassium	48 mg
12	Carotenes	7 mg
13	Vitamin B1	0.04 mg
14	Vitamin C	16.7 mg

A total of 42 volatile constituents were identified in water apple fruit, the largest number and proportion (41.4%) were terpenoids, among which gamma terpinene was dominant .18

Traditional Uses:

Syzygium aqueum is considered a valuable plant in traditional medicine, particularly as a source of natural antioxidants[6]. The fruits, leaves, and bark are used to treat a variety of conditions, including fever, liver disorders, headaches, digestive problems, diabetes, high cholesterol, skin diseases, and potentially some types of cancer. A decoction of the astringent bark is applied locally to treat thrush[15]. In Malaysia, different parts of the plant are commonly used in traditional medicine. The leaves exhibit antibiotic activity, and tribal communities often consume raw leaves to relieve childbirth pain. Powdered dried leaves are used to treat mouth ulcers, while root preparations help reduce itching and swelling.

A decoction made from the bark of *Syzygium aqueum* acts as an effective astringent. Recent studies have highlighted the cosmeceutical potential of leaf extracts, demonstrating antityrosinase, lipolytic, and anticellulite activities, making them useful as cosmetic ingredients. Literature also reports that the leaves possess anticancer and antidiabetic properties[19]. According to traditional Chinese medicine, the

leaves, fruits, and seeds of watery rose apple have antipyretic effects, while the roots act as diuretics. Consuming wax apple fruit during hot summer months is considered effective for Consumption of watery rose apple fruit is effective for quenching thirst, relieving heat stress, and preventing dehydration, making it useful for dispelling summer heat. Salted fruit is traditionally used to ease discomfort in the stomach and intestines. The flowers of watery rose apple are astringent and have been used in the treatment of fever and diarrhea[20].

Pharmacological Properties

Antioxidant Activity: Antioxidants are important for neutralizing free radicals, protecting against oxidative damage, and reducing oxidative stress. Many plant- derived compounds act as natural sources of antioxidants. Consuming foods rich in flavonoids and phenolic compounds can provide health benefits through their antioxidant effects. In vitro studies have shown that *Syzygium aqueum* leaf extract exhibits strong antioxidant activity and can protect human keratinocytes (HaCaT cells) from UVA-induced damage[21].

Anti-inflammatory Activity: describes the ability of a compound to alleviate inflammation and associated pain by interfering with biochemical pathways involved in pain transmission rather than directly acting on the central nervous system.

The polyphenol-rich leaf extract of *Syzygium aqueum* demonstrated notable anti- inflammatory potential. It effectively suppressed the activity of lipoxygenase (LOX), cyclooxygenase-1 (COX-1), and cyclooxygenase-2 (COX-2), showing greater selectivity toward COX-2 compared with conventional anti-inflammatory drugs such as indomethacin and diclofenac. Furthermore, the extract decreased erythrocyte membrane disruption under hypotonic conditions, indicating its membrane- stabilizing and anti-inflammatory properties.

Cosmeceutical Activity: S. aqueum leaf extracts can be used in skin treatments due to their antioxidant activity, tyrosinase inhibitory effects, and potential UVB- blocking properties.[22]

Antidiabetic Activity: Compounds used to regulate blood glucose levels in diabetes mellitus are known as antidiabetic, hypoglycemic, or antihyperglycemic agents. Bioactive constituents in S. aqueum leaf extract have been shown to promote adipogenesis, increase glucose uptake, and enhance adiponectin secretion, highlighting their potential as effective antidiabetic agents.[21]

Hepatoprotective Activity: The ability of a compound to protect the liver from damage is referred to as hepatoprotective or antihepatotoxic activity. S. aqueum leaf extract demonstrated hepatoprotective effects by reducing elevated levels of ALT, AST, total bilirubin (TB), total cholesterol (TC), and triglycerides (TG).

Antimicrobial Activity: Antimicrobial agents are essential compounds used to combat pathogenic microorganisms by either killing them or inhibiting their growth to protect host cells. Ethanolic extracts from three S. aqueum varieties showed activity against *S. aureus*, *B. subtilis*, *E. coli*, and *P. aeruginosa*, whereas no inhibitory effects were observed against *Aspergillus flavus* and *Saccharomyces cerevisiae.23*

Anticancer Activity: Methanol extracts of S. aqueum leaves were evaluated for cytotoxicity using the sulforhodamine B (SRB) assay. Their effects on human breast cancer cells (MDA-MB-231) were compared with doxorubicin, a standard chemotherapeutic agent. The extract exhibited low

toxicity against the cancer cells, with an IC50 value greater than 100 µg/mL.

Antiproliferative Property: The antiproliferative effects of Syzygium fruit, specifically water apple (*S. aqueum*), were investigated against two breast cancer cell lines: MCF-7 (hormone-dependent) and MDA-MB-231 (hormone-independent).

The antiproliferative activity of aqueous and methanolic extracts of *S. aqueum* fruit was evaluated using the colorimetric MTT assay over 24, 48, and 72 hours. The results indicated that the extracts had no significant effect at 24 and 48 hours, but exhibited antiproliferative effects on MCF-7 cells after 72 hours. No effects were observed on the non-cancerous control cell line.

Toxicity

The toxicity of ethanolic leaf extracts of *S. cumini* was evaluated using the brine shrimp lethality assay, with thymol as a standard. Ten brine shrimp larvae were exposed to each extract concentration (10–1,000 µg/mL), and the absence of mortality was used to calculate the LC50 value. The results indicated that the extract exhibited low toxicity compared to thymol [72].

Similarly, ethanolic extracts of *S. guineense* seeds were assessed for toxicity using the brine shrimp lethality assay, with cyclophosphamide as a reference standard. Ten brine shrimp larvae were exposed to concentrations of 24, 40, 80, 120, and 240 µg/mL, and the LC50 was determined based on the absence of mortality. The extract showed low toxicity, with an LC50 value exceeding 100 µg/mL [85].

Phytochemical Screening of *Syzygium aqueum* (Burm. f.) Alston Fruit Extractation [30]

Phytochemical test	Name of the test	E1	E2	E3
Tannins	FeCl3 test and Lead acetate test	+	+	+
Steroids	Salkowski test	_	_	_
flavonoids	Shinoda test	+	+	+
Saponins	Frothing test	_	_	_
Proteins and amino acids	Ninhydrin test	+	+	+
Alkaloids	Hager's, Meyer's and Wagner'stest	+	+	+
Carbohydrates	Molisch's test	+	+	_
Glycosides	Nitroprusside test	+	+	+
Cardiac glycosides	Keller Killiani test	+	+	+
Terpenoids	Salkowski test (modified)	+	+	+
coumarins	Ammonia test	+	+	+
Anthraquinones (emodols)	NaOH test	-	-	_
Reducing Sugar	seliwanoff's test	+	_	_
Starch	Harborne method	+	_	_

E1: Aqueous Extract, E2: Acetone Extract, E3: Ethanol Extract.

Note: the symbol '+' indicates presence and '-' represents absence of the respective phytocompounds in the extra

Health Benefits of Water Rose Apple

Rose apples (S. aqueum) are rich in vitamin C, which helps protect the body against damage caused by toxins, pollutants, and free radicals—factors associated with conditions such as cancer, cardiovascular disease, and arthritis. Free radicals are generated in the body through radiation exposure, tobacco use, smoke inhalation, and normal food metabolism. Vitamin C acts as an antioxidant, reducing oxidative stress, supporting the production and function of white blood cells, and promoting overall cellular health. Additionally, it is believed to strengthen the

immune system, contributing to protection against common infections such as colds.[7]

- **Boosts Good HDL Cholesterol:**

1. **Rich in Niacin:** Rose Apple is a natural source of niacin, a nutrient that regulates cholesterol levels.
2. **Increases HDL Cholesterol:** Niacin supplementation is associated with increased HDL 2cholesterol levels and decreased levels of triglycerides and LDL cholesterol.

- **Prevents Diabetes:**

1. **Reduces Blood Glucose Levels:** Consumption of Rose Apple leads to a reduction in blood glucose levels by enhancing the activities of key carbohydrate metabolic enzymes.
2. **Enhances Enzyme Activity:** Rose Apple supports the activities of glucose-6- phosphate dehydrogenase, hexokinase, and glucose-6-phosphatase.

- **Prevents Constipation:**

1. **Rich in Dietary Fibres:** Rose Apple contains dietary fibres that promote regular bowel movements and alleviate constipation.
2. **Supports Digestive Health:** Fibres in Rose Apple support overall digestive health and contribute to maintaining a healthy weight.

CONCLUSION

Information on S. aqueum was gathered from global publications and review articles, revealing its rich array of phytochemical constituents. Various parts of the plant exhibit pharmacological properties including antioxidant, hepatoprotective, anti- inflammatory, antidiabetic, cosmeceutical, antimicrobial, anticancer, and antiproliferative effects. The review provides insights into the botanical description, geographical distribution, nutritional value, traditional uses, pharmacological properties, and health benefits of S. aqueum. It underscores the potential for identifying lead drugs from the plant's diverse bioactive compounds, which have been utilized since ancient times without full understanding of their chemical composition. This review serves as a catalyst for further research on S. aqueum.

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