



# **Mangrove's Plant: An updated Review on Ethnobotanical, Phytochemical and Pharmacological Potential of *Barringtonia racemosa***

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## **Authors' contributions**

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## **ABSTRACT**

The conventional usages and traditions of people in *Barringtonia racemosa* (L.) (*B. racemosa*) mangrove plant species in their day-to-day life and therapeutic techniques. *B. racemosa* (L.) belongs to family Barringtoniaceae, with single-seeded, oval-shaped fruit and a tall tree dispersed in India's east and west coasts. *B. racemosa* (L.), titled as putat, a fish poison tree or powder puff tree, is a precious plant species due to its medicinal values. Its fruit pulp is used in fish poison and diarrhea, asthma, coughs, analgesic and antipyretic, and has significant antitumor activity. Flavonoids and phenolic acids are the primary metabolites of the leaves and are used to reduce hypertension and purgative. In addition, the pulverized leafage, barks, and roots are used to lessen the inflammation and chickenpox. Among the phenolic compounds specified in the leaves of *B. racemosa* (L.) include ferulic acid, naringin, gallic acid, rutin, luteolin, protocatechuic acid, kaempferol, quercetin, and ellagic acid. Conventional remedial practices have the whole plant as a therapy for itch; the antimalarial activity is reported in roots. The bark or leaf are used in abscesses, sores, serpent bites, rat poisonings, gastric ulcers, hypertension, chickenpox. In contrast, the kernels or seeds are sourced for carcinogenic disorders and eye inflammation. The current review emphasized the ethnobotanical, phytochemistry and pharmacological activities of *B. racemosa* (L.) proved through various scientific facts.

**Keywords:** Traditional medicine; putat; antitumor; flavonoids; ethnobotanical; fish poison.

## 1. INTRODUCTION

Since the ancient eras, plants used as a vital resource of drugs due to their pharmaceutically major constituents of bioactive elements [1]. Mother nature has a wide variety of plant genera, and the presence of the plant realm delivers countless advantages concerning humankind. Plants may indeed use for emotional, mystical, social, and therapeutic components. Traditional applications of the plants and their relations with individuals are named ethnobotany that wholly interrelated with social ritual and faith. Certainly, the ethnobotanical method grounded on the native practices of plants may be the root cause for advanced methodical research in phytochemical screening and pharmacological studies [2]. It acknowledged that remedial plants could impart treatment for several disorders and illnesses due to biologically active compounds of plants isolated from plant-specialized end products. There are plentiful findings that authenticated so far, stating the significance of biologically active compounds of plants in natural product breakthrough [3]. One of the utmost broadly dispersed mangrove plant varieties with innumerable eminent uses is *B. racemosa* (L.), commonly known as fish poison tree or powder puff tree or putat, Hippo apple, Wild guava. It belongs to Barringtoniaceae (Lecythidaceae) family and wildly grows in tropical areas [4].

Taxonomically this species belongs to –

Kingdom : Plantae  
 Subkingdom : Viridiplantae  
 Super division : Spermatophytina  
 Phylum : Tracheophyte  
 Class : Magnoliopsida  
 Order : Ericales  
 Genus : *Barringtonia*  
 Species: *racemosa*

Other species belonging to this genus are *B. acutangula*, *B. macrostachya*, *B. edilus*, *B. asiatica*, *B. spicata*, and *B. lanceolata* [5]. This mangrove plant species grows well in watery and wet areas such as lakes, swamps, and river banks with an approximate height of 8 to 15 m [6]. The Philippines is the native place for *B. racemosa* (L.) species. Still, its habitation comprises regions involving India, Sundarbans, Assam and Andaman Islands, Madagascar, Eastern Africa, East Asia, and Polynesia [7]. Various parts of this plant are edible, like young

leaves and fruits sold in the Peninsular Malaysian *pasar minggu*. The young leaves are eaten raw as ulam used in cooked vegetables or dipped in sambal. The fruits are also used as pickles or ulam to extract starch to prepare cakes. Nevertheless, less effort in encouraging commercialization and expansion *B. racemosa* (L.) gets less attention and grouped under-utilized crops reported by the Malaysian Ministry of agriculture and Malaysian Agricultural Research and Development Institute (MARDI) [8]. It is called by various names in different languages [5].

Language	Name
Sanskrit	Samudraphala
English	Common Putat, Hippo Apple, Fish-Poison Tree, Fish-Poison Wood, Wild Guava, Powder-Puff Tree, Brack-Water Mangrove, Small-Leaved Barringtonia Fish-Killer Tree, Freshwater Mangrove
Swahili	Mtomondo
Hindi	Ingar, Ijjul
Indonesian	Putat Sungai, Butan Darat, Peng Gung,
Thai	Chik Ban, Chik Suan
Burmese	Kye-Bin, Kyi
Sri-Lanka	Godamidella
Tamil	Arattam
Malaysia	Putat Ayam, Putat Aying, Putat Ayer, Putat Kampong
Chinese	Yu Rui
Philippines	Putat (Samar-Leyte Bisaya), Kutkut-Timbalon, Putat (Samar-Leyte Bisaya)
Marathi	Nivar, Sadphali

### 1.1 Phytology

*B. racemosa* (L.) is a small tree with clustered leaves at the end of the branches and greyish brown bark arranged alternately [7]. Leaves have serrated margins and are oblong-obovate in shape with 15 cm wide and 40 cm length. Flowers are bisexual, sepals merged at the base and divided into four lobes pale pink to white, ooze out putrefied, intense yet slightly pleasant odor. Inflorescences are long and drooping with prominent stamen organized in elongated prickles stretching out of the midpoint of leaf clusters [5]. Due to nectar in flowers when ants eat shed, they blossomed at night and fall in the morning. Fruits are green to tinged green, and after ripening, it turns purplish-red. Each fruit has

spongy flesh, fibrous around the seed oval shape and size about the chicken eggs. The seeds lie in the innermost part of the fleshy fruit about 2 to 4 cm in length and carry a single-seed [9]. Table 1 and Fig. 1 show its botanical description [10,9,11,12].

## 1.2 Poisonous Tree

This tree is called a fish-killer, fish poisonwood, and fish-poison tree can poison fishes [14,15]. In the area of Pacific islands, it is used to startle the octopus and fishes where the species are innate. Therefore, the fishes are shocked when the crushed constituents of *B. racemosa* (L.) spread

via fish's gills or swallowed directly. *B. racemosa* (L.) crushed parts are commenced into slow-flowing pools or rivers, and with that, the poisons are deliberated and hence not washed away quickly by the water current [16]. The poison is ascribed to its saponin and tannin content used by fishes as animal poison [15]. In the Philippines, this toxin of *B. racemosa* (L.) is used to poison fishes and wild pigs and used as insecticides against citrus aphids [17]. In Bangladesh, some of the districts are used as snake and insect repellents [18-20]. Interesting facts towards this Lecythidaceae family species parts like fruits and seeds proven scientifically have anti-plasmodial, piscicidal, molluscicidal, larvicidal, and cercariacidal properties [21,22].

**Table 1. Botanical description (parts and their characteristics) of *B. racemosa* (L.)**

Parts	Characteristics
Leaves	Alternate, simple; with the stipules very small and caducous, oblong-obovate and have serrated margins, clustered at the end of branches, packed near the ends of twigs, the base of leaves is cuneate, narrowly tapered and move towards petiole with acuminate and deep green apex.
Fruits	It has single-seed with pear or chicken egg-shaped and oblong (about 2 to 5.5 cm * 3 to 9 cm) and with persistent calyx, the style is fleshy, but after maturation, it turns yellowish-brown fleshy hard. The color of fruits is green with a purple and dark red tinge.
Flowers	Long, pendulous inflorescences, with noticeable stamens carrying numerous pink flowers with fragrance, sepals are joined at base divided into 4 to 5 lobes, bisexual, it showed with red style and ovary having 2-4 chamber.



**Fig. 1. *B. racemosa* (L.) A-Inflorescence; B-Fruit; C-Androecia and petals [13]**

### 1.3 Nutritional Value with Other Uses

The leaves of *B. racemosa* are usually served at dinner and lunchtime as a salad with shrimp paste, especially in Malay [23]. In certain parts of the world, it is used to cook as edible flour by grinding the seeds. They are crushed to remove the starchy substance, and these pulverized seeds are used to make foodstuffs like cakes [11,9]. The fruits and shoots of *B. racemosa* (*L.*) are excellent for elderly people and are eaten raw only. The texture of young fruits is crunchy and consumed as such [24]. The Republic of Palau people used the *B. racemosa* for personal hygiene like soap, shampoos, and liquid detergents because of its saponin content and

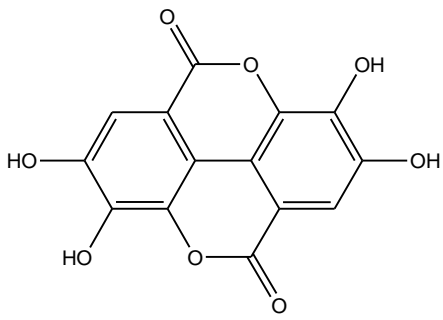
validated by several studies [25-28]. The bark of roots and stem has a tannin content of *B. racemosa* (*L.*), is a good source of dye for vegetable fibers, and provides a reddish to brown color to the leather. The wood and seeds are also good sources of firewood and oil from seeds used for lightning [9]. Apart from the above uses, it is an ornamental and decorative plant because of its unique characteristics and attractive texture of flowers and fruits of *B. racemosa* (*L.*) [11,9,29]. Its ethnomedicinal properties, phytochemistry, and pharmacological activities are summarized in Tables 2-4. Structures of phytoconstituents are present in various parts of it depicted in Fig. 2 [30-33].

**Table 2. Ethnomedicinal properties of *B. racemosa* (*L.*)**

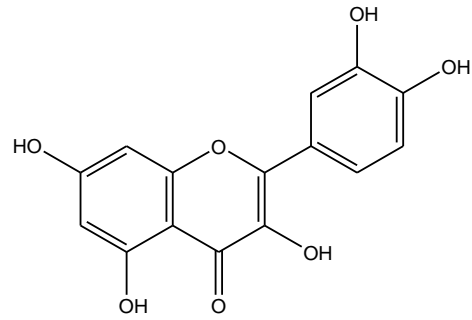
Parts	Application	References
Leaves	Scabies, hypertension, snake repellent, ear disorders like otitis media, joint pain, fracture for the bone, pain, snake bite treatment as a decoction	[11,19,20,34-37]
Fruits	Malaria, asthma, diarrhea, skin disorder(powdered) and cough	[11,9,38]
Bark	Rheumatoid, crushed bark for chicken pox and itching, hallucinations	[11,9,35,39]
Roots	Decoction used in Snake poisoning, fever	[24,35,40]
Seeds	Skin ointment, cough, asthma, eye disorder, jaundice, parturition, stomach-ache, antidote, anti-diabetic, anticancer	[11,9,41,42]

**Table 3. Phytochemistry of various parts of *B. racemosa* (*L.*)**

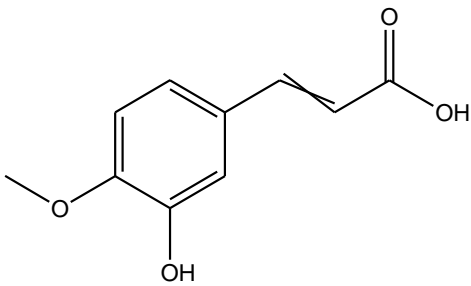
Parts	Active constituent	References
Leaves	Phenolic compounds, ellagic acid and quercetin, protocatechuic acid, ferulic acid, gallic acid, luteolin, naringin, rutin, kaempferol, $\beta$ -carotene, lycopene	[43,44]
Stem bark	Betulinic acid, lupeol and taraxerol, olean-18-en-3beta-O-E-coumaroyl ester and Olean-18-en-3beta-O-Z-coumaroyl ester, bartogenic acid, 3',3'-dimethoxy, proanthocyanidins (tannins), germanicol, germanicone, ellagic acid	[9,45]
Fruits	Bartogenic acid, quercetin and kaempferol (flavanols), barringtogenol, R1-barrigenol and barringtogenic acid (saponins) showed barringtonin and sapogenins	[23,46-50]
Shoots	Protocatechuic acid, gallic acid, and ellagic acid, rutin, quercetin, and kaempferol are called phenolic acids (flavonoids)	[23]
Seeds	Sapogenins and saponins like barringtogenol, R1-barrigenol, and barringtogenic acid	[49]
Roots	It contains two diterpenoids dimethyl-15,16-epoxy-3,13(16),14-neo-cleroda-trien-17,18-dicarboxylate (17-carboxymethyl-hardwickiic acid methyl ester, nasimalun B,2) and methyl-15, 16-epoxy-12-oxo-3,13(16),14-neo-clerodatrien-18,19-olide-17-carboxylate (nasimalun A, 1)	[50]



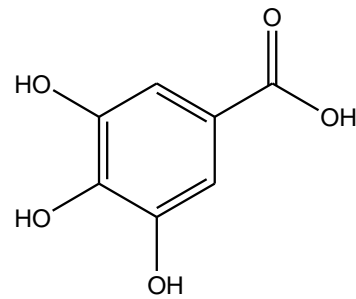
**Ellagic acid**



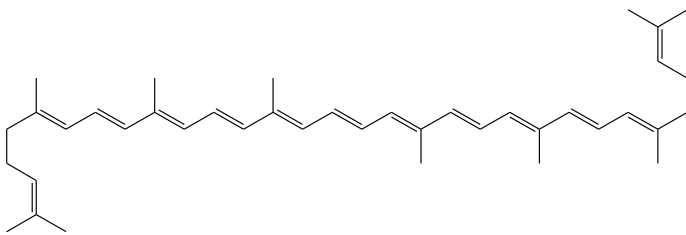
**Quercetin**



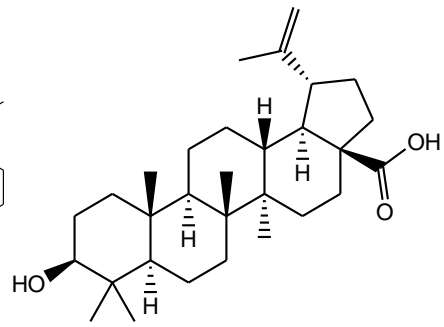
**Ferulic acid**



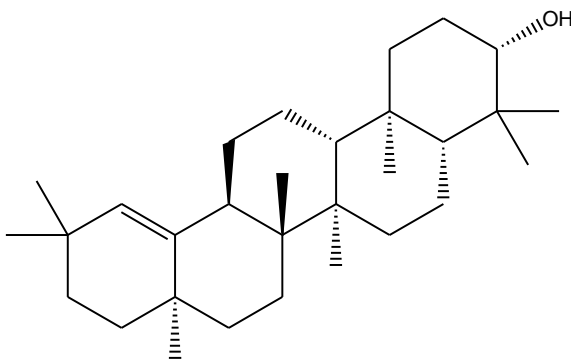
**Gallic acid**



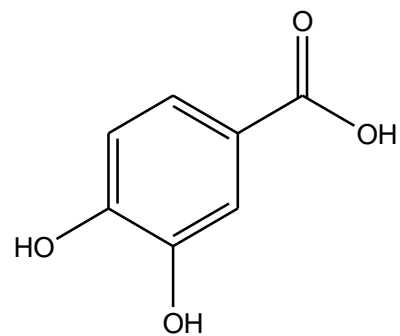
**Lycopene**



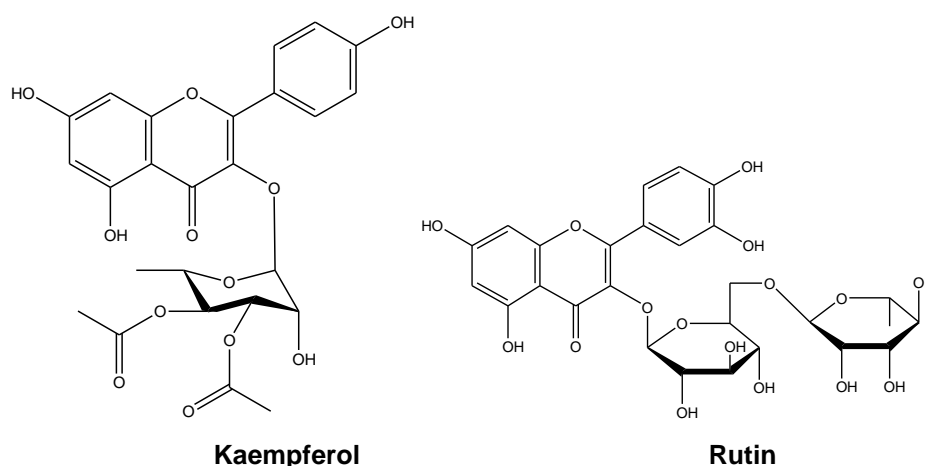
**Betulinic acid**



**Germanicol**



**Protocatechuic acid**



**Fig. 2. Structure of phytoconstituents of *B. racemosa* (L.)**

**Table 4. Pharmacological applications of *B. racemosa* (L.)**

Plant parts	Extract	Pharmacological Application
Aerial part	Methanolic extract contain higher phenolic content than Ethanolic, Hexane and Chloroform	Antioxidant and anti-inflammatory [51] Antifungal [52]
Fruits	Ethanolic extract, Pericarp extracts	Anti-Inflammatory and Analgesic [53] Larvicidal, Molluscicidal [54]
Seeds	Ethanolic extract, Hexane, Ethanol, and Methanol	Antitumor [55], Alpha-glucosidase inhibitor activity [56]
Roots	Ethanol extract	Antibacterial activity [57]
Leaves	chloroform extract ensued by extracts of hexane and ethanol, aqueous extract	Antioxidant and anti-inflammatory [58], Anticancer [59], Cytoprotective [60]
Bark	Methanolic extract, Ethanolic bark extract	Antifungal [52], Anti-diarrheal [61]

## 2. CONCLUSION

This review highlighted countless traditional medicinal importance, phytochemistry, and pharmacology activities of *B. racemosa*(L.) and may play a pivotal role in future study and researcher. Therefore, the plant species has good future potential for breakthrough novel molecules and pharmacological activities. Since the utility of this mangrove plant and its resourceful purposes in social livings, *B. racemosa* (L.) certainly has countless possibilities to be broadened calculated due to its functional biological compounds. In addition to its plant constituents, several complexes in the class can be further discovered to yield productive pharmaceutically vital compounds and dyeing and coloring substances. In the meantime, gap to explore in this area of plant biotech in this species. Henceforth, the study in the respective location on *B. racemosa* (L.) may be increased and expanded to certify the benefits of *B. racemosa* entirely utilized via further experimental research.

## NOTE

The study highlights the efficacy of "Traditional medicine" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

It is not applicable.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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