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"EXPLORING THE BOTANICAL, NUTRITIONAL, AND PHARMACOLOGICAL POTENTIAL OF *BACCAUREA MOTLEYANA* (RAMBAI)"

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ABSTRACT: Since ancient times, *Baccaurea* species have held economic value for the indigenous peoples of the Old-World Tropics, used for both their edible fruits and medicinal properties. Among these, *Baccaurea motleyana*, commonly known as Rambai, is notable for its diverse uses and is widely cultivated across Southeast Asia. This study explores the botanical characteristics, traditional applications, and pharmacological potential of *B. motleyana*. Rambai thrives in tropical rainforests and diverse soil types, growing up to 25 meters tall. The fruit is consumed fresh, while various plant parts are used medicinally to treat ailments such as constipation, eye swelling, arthritis, and abdominal pain. Notably, the bark is used to prevent postpartum hemorrhage, and the leaves treat menstrual disorders. Nutritionally, Rambai fruits are rich in vitamins and minerals, including vitamin C and potassium, and exhibit antioxidant and antimicrobial properties due to their high phenolic content. Phytochemical screening reveals the presence of alkaloids, flavonoids, saponins, triterpenoids, and tannins, contributing to its medicinal properties. Pharmacological studies highlight its antioxidant, antimicrobial, antidiabetic, and anticancer activities. For instance, the ethanolic extract of Rambai peel demonstrates significant hypoglycemic effects in mice, while its antioxidant activity is attributed to phenolic compounds. This study underscores the traditional and medicinal significance of *B. motleyana*, suggesting its potential in developing natural therapeutic agents. Further research is warranted to explore its bioactive compounds and therapeutic applications comprehensively.

INTRODUCTION: Since ancient times, there has existed a lesser-known category of plants that held significant economic value for the indigenous people of the Old World Tropics. This category encompasses various species of *Baccaurea*, a considerable genus of perennial trees that thrive across regions from India to the Pacific ¹.

Though the *Baccaurea* genus encompasses fruit-bearing plants, it is not as widely recognized as other fruit-producing plants. Beyond consuming the fruit fresh and utilizing the wood for construction, communities have used *Baccaurea* species medicinally to address various ailments such as constipation, eye swelling, arthritis, abdominal pain, and to aid menstruation and urination ².

This genus classified within the Phyllanthaceae family. This family is considered a distinct group from the broader Euphorbiaceae family, along with four other families: Euphorbiaceae proper, Pandaceae, Picrodendraceae, and Putranjivaceae ³. The review of literature on *Baccaurea* revealed that

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some species in this genus have been traditionally used by indigenous communities in South Asia to treat various illnesses due to their medicinal properties. *Baccaurea motleyana*, a member of the Phyllanthaceae family, is native to areas such as Kalimantan, Java, Sumatra, Bali, and Peninsular Malaysia. This tropical plant, known as Rambai in English and locally in Indonesia and Malaysia, is cultivated for its fruit across Southeast Asia, including in the Philippines, Thailand, India, and Bangladesh ⁴. In its natural habitat, it can be found in lowland primary and secondary tropical rainforests, open scrublands, and occasionally in riparian forests. It is commonly grown in home gardens. This plant thrives in various soil types, including alluvial soils, yellow clay, sand, or limestone, at altitudes ranging from 10 to 750 meters.

Vernacular Names ⁵:

Borneo: Pekan, Rambai (Iban), Rambai (Malay), Ulup-Lavai (Punan) Bua Trai, Pekang, Rambai, Ramei.

Chinese: Duo Mai Mu Nai Guo.

Indonesia: Rambai (Sumatra), Menteng (Java), Sekoyun (Lun Daye, Mentarang, Kalimantan), Pahae (Merap, Malinau, Kalimantan).

Peninsular Malaysia: Rambai, Rambeh.

Philippines: Rambai (Tagalog).

Singapore: Rambai, Buah Jentik, Asam Lambun.

Origin and Distribution: This species is indigenous to Thailand, Peninsular Malaysia, Sumatra, Java, Borneo (including Sarawak, Brunei, Sabah, West, South and East-Kalimantan), and the Moluccas. It is also cultivated in other tropical

regions of Southeast Asia, Northern Australia, and Yunnan in China ⁵.

Taxonomical Classification of *Baccaurea Motleyana*:

Kingdom	Plantae
Sub-kingdom	Viridiplantae
Infra-kingdom	Streptophyta
Superdivision	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Rosanae
Order	Malpighiales
Family	Phyllanthaceae
Genus	Baccaurea
Species	<i>Baccaurea motleyana</i> Müll. Arg.

Morphological Characteristics: The Rambai tree Fig. 1 is a large and densely leafy plant that can grow to a height of 9 to 25 meters. Its trunk can extend up to 0.4 meters in length. The leaves are spirally arranged, flat, glossy on the top and darker green on the underside, measuring 15 to 33 cm in length and 7.5 to 15 cm in width, with 12 to 16 pairs of lateral veins. The branchlets are cylindrical and densely hairy. The fruits are spherical to ellipsoid, 2.5 to 4 cm long, containing three seeds, and are indehiscent berries that turn greenish-yellow to whitish-yellow when ripe. They usually form in attractive clusters on the older branches and trunk. The ripe fruits are also spherical to ellipsoid, 2 to 5 cm long, and have three to five seeds. The edible portion of the fruit is the juicy, translucent pulp, which tastes sweet to sour. The flower of this plant are spirally arranged, 15-33cm long, 7.5-15cm wide. The seeds are ellipsoid, compressed longitudinally, and brown, measuring 13 to 20 mm by 9 to 15 mm. The arillode is opaque, varying in color from white to purple ^{4, 5}.



FIG. 1: *BACCAUREA MOTLEYANA* PLANT AND DIFFERENT PARTS OF IT ⁶

Traditional Use: *Baccaurea motleyana* Müll. Arg., commonly known as Rambai, is an edible fruit plant native to the tropical rainforests of East Kalimantan. This plant is also found in several Asian regions, including Malaysia, Thailand, and Indonesia. Traditionally, the bark has been used in various preparations given to women to prevent postpartum hemorrhage⁵. Rambai is also used to treat stomach and eye diseases and has shown potential as an anticancer agent⁷. The inner bark of the Rambai tree is known for its ability to alleviate infections, reduce inflammation, and address various eye issues. This bark can be sourced from both young and mature trees, although the bark from older, fruit-bearing trees is the most potent. To obtain the inner bark, the outer layer is peeled away. The inner bark is then cleaned, wrapped in a cloth, and pounded so the cloth absorbs the extract. The cloth is subsequently squeezed to release the extract, which is applied to the eyes three times daily until the condition improves. In traditional cosmetic industries in countries like Malaysia and Indonesia, Rambai peels are used to treat acne and other skin disorders and are also consumed as vegetables. Additionally, the fruits are employed to treat bacterial infections^{8,9}.

The fruit peel is used internally following childbirth. Additionally, the bark is included in a mixture of various ingredients that is also administered internally after childbirth as a protective medicine. Rambai bark is a component of "Rempah Ratus" (the hundred herbs), a blend of numerous roots, spices, and herbs given to mothers after childbirth. The ingredients are soaked in a large pot of water, and a portion of the liquid is filtered and given to the mothers each morning as a potion. Additionally, an extract is applied to their waist, and the old ingredients are regularly replaced with a fresh assortment¹⁰.

The leaves of the Rambai tree are used as a treatment for menstrual disorders¹¹. In Khao Phanom Bencha National Park, Krabi Province, Thailand, different parts of the Rambai tree are used as a blood tonic for women's health care. These parts are boiled in water and consumed as a beverage¹². The Dayak Iban tribe of Central Ketungau District in Sintang Regency, Indonesia, uses the peel of the Rambai fruit to treat strep throat¹³. The Dayak Seberuang tribe in Sepauk

District, Sintang Regency, Indonesia, consumes a decoction made from boiled parts of the *Baccaurea motleyana* tree to treat malaria¹⁴. In an interview with a female folk medicinal practitioner from Narayanganj district, Bangladesh, it was disclosed that she utilizes the leaves and roots of *Baccaurea motleyana* trees to treat stomach ailments and persistent fevers. Patients take these leaves and roots orally¹⁵.

Nutrients Presents in Rambai: It is reported that Food nutrient composition of fresh arillode of *Baccaurea motleyana* per 100 g edible portion consist energy 64 kcal, water 83.7 g, protein 0.4 g, fat 0.4 g, carbohydrate 14.6, fibre 0.1 g, ash 0.2 g, Ca 5 mg, P 13 mg, Fe 0.2 mg, Na 2 mg, K 111 mg, vitamin B1 0.02 mg, vitamin B2 0.05 mg, niacin 0.2 mg and vitamin C 6.2 mg¹⁶. The following nutritional values per 100 g of the edible portion were reported: energy 65 kcal, moisture 79.0%, protein 0.2 g, fat 0.1 g, carbohydrates 16.1 g, dietary fiber 0 g, ash 3 g, phosphorus (P) 20 mg, potassium (K) 0 mg, calcium (Ca) 13 mg, iron (Fe) 0.8 mg, and vitamin C 5 mg. (E)-Hex-2-enal was identified as the primary volatile compound in rambai fruit, which also contained significant amounts of methyl 2-hydroxy-3-methylbutanoate, methyl 2-hydroxy-3-methylpentanoate, and methyl 2-hydroxy-4-methylpentanoate¹⁷.

The leaves, stems, pericarps, and fruits of Rambai from Singapore were analyzed for alkaloid content. The fruits, in particular, produced strong precipitates with Buchardat's, Dragendorff's, and Mayer's reagents, indicating a significant presence of alkaloids¹⁸. The nutritional content of the fruit is influenced by several factors, including cultivation techniques, geographic location, climate, plant age, and growth conditions.

The Rambai fruit pulps were sliced, frozen, freeze-dried, ground into powder, extracted with 80% methanol at a 1:4 ratio, and filtered. The total phenolic content (TPC) was measured at 1160.14 ± 20.56 mg GAE per 100 g of Rambai pulp, and the antioxidant capacity was found to be 71.17% in the Rambai fruit pulp¹⁹. Rambai fruits are composed of 83.7 g of water per 100 g, classifying them as "fleshy fruits." They are packed with essential nutrients such as vitamins and minerals, along with physicochemicals including fibers, proteins,

carbohydrates, and a low fat content²⁰. Consuming two to three Rambai fruits fulfills the daily vitamin C requirements. Vitamin C is the predominant vitamin in Rambai, followed by vitamin B3. In ripe fruits, potassium is the most prevalent mineral. The mineral content of the fruits varies due to factors such as soil fertility, climate, and stages of maturity. Carbohydrates are the predominant component in fruits and greatly influence their sensory attributes, especially sweetness. Fruits are generally rich in the monosaccharides fructose and glucose, although their amounts and proportions vary by species. Fresh *B. motleyana* contains approximately 16.1 g of carbohydrates per 100 g of its edible portion²¹.

The polyphenol content and antioxidant activity of whole Rambai fruits were evaluated. The fruits were dried, ground, and soaked in methanol at a 1:4 ratio before being filtered and concentrated. The total polyphenol content was measured at 0.05 g GAE per 100 g of dried fruit and 0.29 g GAE per 100 g of extract. The extract's IC₅₀ and TEAC (Trolox equivalent antioxidant capacity) values were recorded as 5090.11 and 0.003, respectively. These findings suggest that whole Rambai fruits have very low polyphenol content and weak antioxidant activity²².

Four organic acids citric acid, tartaric acid, malic acid, and oxalic acid were identified in Rambai fruit, listed in descending order of predominance. The edible part of the fruit was cut, ground into a slurry, homogenized with 80% aqueous methanol in a 1:10 ratio, and ultra-centrifuged. The supernatant was used for measurements. Citric acid content in young, mature, and ripe fruit pulps was 6.11, 5.24, and 4.65 mg/100 g EP, respectively. Malic acid content was 0.55, 0.69, and 0.62 mg/100 g EP, respectively. Tartaric acid levels were 4.37, 4.07, and 3.65 mg/100 g EP, respectively, and oxalic acid levels were 0.20 mg/100 g EP in young and mature fruit, and 0.19 mg/100 g EP in ripe fruit. Total acid (TA) content measured 11.22, 10.19, and 9.11 mg/100 g EP in young, mature, and ripe fruit pulps, respectively. TPCs were 97.23 ± 3.79 , 63.90 ± 1.73 , and 79.57 ± 3.06 mg GAE/100 g EP, and DPPH scavenging (antioxidant) activities were $13.10 \pm 0.34\%$, $3.10 \pm 0.59\%$, and $6.47 \pm 0.66\%$ in young, mature, and ripe pulps, respectively. No IC₅₀ values were detected at any

maturity stage. A positive linear correlation was observed between the TPC and antioxidant activities in *Baccaurea motleyana* fruit extracts. As the fruits progressed from young to ripe, the total acidity (TA), total polyphenol content (TPC), and antioxidant activities all decreased²³. In *Baccaurea motleyana* fruit extracts, a positive linear correlation was found between total polyphenol content (TPC) and antioxidant activities. As the fruits matured from young to ripe, both total acidity (TA), TPC, and antioxidant activities showed a decline²⁴.

The phytochemical content and antioxidant activity of Rambai stem were analyzed. Samples were macerated, soaked in methanol twice, filtered, and concentrated to obtain a crude extract, which was then fractionated with n-hexane and ethyl acetate (EA) to yield n-hexane, EA, and remaining methanol fractions. Alkaloids were detected in the crude extract and n-hexane fraction. Phenolic compounds were present in all fractions except the n-hexane fraction. Saponins were found in all fractions except the remaining methanol fraction. Flavonoids were present in the crude extract and EA fraction, while terpenoids were only found in the remaining methanol fraction.

Steroids were absent in all extracts. Using the DPPH method, IC₅₀ values were determined to be 127.1032 ppm for the crude extract, 58.2275 ppm for the n-hexane fraction, 32.3562 ppm for the EA fraction, and 56.4567 ppm for the remaining methanol fraction. Lower IC₅₀ values indicate stronger antioxidant activity, making the EA fraction the most potent antioxidant among the extracts. Based on the IC₅₀ scale, ≤ 50 ppm is considered very strong, 50-100 ppm is strong, 105-150 ppm is moderate, and 151-200 ppm is weak. Thus, the EA fraction demonstrated very strong antioxidant activity, the n-hexane and remaining methanol fractions had strong activity, and the crude extract exhibited moderate activity²⁵.

Phytochemical Screening of *Baccaurea motleyana*: Medicinal plants contain natural substances that impact the human body. These bioactive compounds, including tannins, alkaloids, carbohydrates, terpenoids, steroids, and flavonoids, are produced through the metabolic processes of living organisms.

These secondary metabolites, though their functions are often not well understood, are widely used in human medicine, veterinary care, agriculture, research, and various other fields. In phytochemical screening, aqueous and organic extracts are prepared from plant parts such as leaves, stems, roots, or bark, which are rich in secondary metabolites. These extracts are then analyzed to identify the presence of compounds like alkaloids, terpenes, and flavonoids ²⁶. Following extraction using the maceration method,

the phytochemical analysis revealed that the ethanol extract contained more secondary metabolites compared to the ethyl acetate and hexane extracts. The ethanol extract (EBM) was found to have alkaloids, flavonoids, saponins, triterpenoids/steroids, and tannins. In contrast, the ethyl acetate extract (EABM) contained flavonoids, saponins, triterpenoids/steroids, and tannins, but no alkaloids were detected. The hexane extract (HBM), on the other hand, only contained triterpenoids and steroids.

TABLE 1: PHYTOCHEMICAL COMPOUND OF *BACCAUREA MOTLEYANA* EXTRACT ²⁷

Compound	Dried powder	Extract		
		EBM	EABM	HBM
Flavonoid	+++	+++	++	-
Saponin	++	+	+	-
Triterpenoid/steroid	+++	+++	+++	+++
Tanins	+++	+++	++	-
Alkaloid	++	++	-	-

+ = detected, - = not detected, EBM= ethanolic extract of *Baccaurea motleyana*, EABM = ethyl acetate extract of *Baccaurea motleyana*, HBM = hexane extract of *Baccaurea motleyana*.

Pharmacological Activity:

Antioxidant Activity: An antioxidant is a compound that delays or prevents the oxidation of other molecules. Oxidation can generate free radicals, initiating chain reactions that can harm cells. By donating electrons, antioxidants neutralize free radicals, thus safeguarding cells and tissues from oxidative damage. This protective action is vital for overall health and is thought to contribute to the prevention of several diseases, including cancer, heart disease, and age-related conditions ²⁸. Phenolic compounds possess robust antioxidant attributes, effectively counteracting free radicals and shielding cells and tissues from oxidative harm. Studies indicate that phenolic compounds present in a variety of foods, such as fruits, vegetables, nuts, and seeds, substantially enhance their antioxidant capabilities. Consistent inclusion of phenolic-rich foods in the diet is linked to a plethora of health advantages, including a decreased likelihood of chronic illnesses such as cancer, cardiovascular disease, and neurodegenerative disorders ²⁹. The methanolic fruit extract of *B. motleyana* demonstrated considerable antioxidant potential ($71.17 \pm 5.63\%$) based on the β -carotene bleaching assay ³⁰.

Antimicrobial Activity: An antimicrobial agent refers to a chemical compound that either kills or slows the growth of microorganisms, including

bacteria, fungi, viruses, and parasites. These substances may originate from natural origins or be artificially created and find application in diverse fields such as medicine, agriculture, and food preservation to manage or eradicate detrimental microorganisms ³¹. Pathogenic bacteria are accountable for a broad spectrum of illnesses in humans, animals, and plants. A notable example is *Streptococcus pyogenes*, which can trigger strep throat, scarlet fever, rheumatic fever, and necrotizing fasciitis. This bacterium is highly virulent and produces various toxins that bolster its pathogenicity. Another significant pathogen is *Staphylococcus aureus*, recognized for instigating skin infections like boils and impetigo, along with more severe conditions such as pneumonia, food poisoning, toxic shock syndrome, and septicemia. *Staphylococcus aureus* displays a remarkable capability to evade the immune system and develop antibiotic resistance. Furthermore, specific strains of *Escherichia coli* (e.g., *E. coli* O157:H7) are pathogenic and can induce gastroenteritis, urinary tract infections, and hemolytic uremic syndrome, primarily through the production of potent toxins that harm intestinal and kidney tissues. Lastly, *Mycobacterium tuberculosis*, the causative agent of tuberculosis, persists as a significant global health concern. This bacterium infects the lungs and can disseminate to other body parts, resulting in severe

respiratory and systemic symptoms. Its ability to endure in a dormant state and its resistance to numerous antibiotics render it particularly challenging to manage and treat^{32, 33, 34}. Crude plant samples were tested for antimicrobial susceptibility using the disc diffusion method. The most prevalent pathogenic microorganisms were selected for screening, including five Gram-positive bacteria (**Bacillus cereus**, **Bacillus megaterium**, **Bacillus subtilis**, **Staphylococcus aureus**, and **Sarcina lutea**), eight Gram-negative bacteria (**Salmonella paratyphi**, **Salmonella typhi**, **Vibrio parahaemolyticus**, **Escherichia coli**, **Vibrio mimicus**, **Shigella dysenteriae**, **Pseudomonas aeruginosa**, and **Shigella boydii**), and three fungi (**Saccharomyces cerevisiae**, **Candida albicans**, and **Aspergillus niger**). Ciprofloxacin (5 µg/disc) and fluconazole (5 µg/disc) served as reference drugs for antibacterial and antifungal activities, respectively.

Nutrient agar plates were inoculated with standardized inocula of the test microorganisms, and PDA media was used for fungi. Filter paper discs (6 mm diameter) loaded with test samples (BMSCME, BMSASF, BMSPSF, BMSDSF, and BMS ESF) were distributed on the nutrient media surface, with a solvent-containing blank disc as the negative control. After 24 hours of incubation at 37°C for bacteria and 25°C for fungi, the inhibition zones were measured in millimeters to determine the plant samples' effectiveness against the microorganisms. The test was conducted three times, and the average diameter was recorded. In a separate test for hypoglycemic activity, *Baccaurea motleyana*'s effect on blood glucose levels was measured in mice. After treating the mice with a 10% glucose solution, blood glucose levels were recorded at 0, 30, 60, and 120 minutes using a glucometer, and the percent reduction in blood glucose was calculated⁶.

Antidiabetic Activity: Diabetes mellitus is a chronic condition that disrupts glucose metabolism, leading to significant clinical implications. It results in complications affecting various bodily systems, including microvascular issues such as retinopathy, nephropathy, and neuropathy, as well as macrovascular problems like ischemic heart disease, stroke, and peripheral vascular disease.

The prevalence of diabetes has been steadily increasing, primarily due to the global surge in obesity rates. This condition is associated with premature morbidity and mortality, decreased life expectancy, and imposes significant financial and other burdens on patients, caregivers, and the healthcare system, rendering it a pressing public health concern. The classification and diagnosis of diabetes are intricate and have undergone extensive deliberation, discussion, and refinement over recent decades. Expert panels from organizations such as the World Health Organization (WHO) and the American Diabetes Association (ADA) have contributed to these deliberations, presenting differing perspectives on diagnostic criteria based on fasting glucose levels or 2-hour post-load glucose measurements. Currently, there is ongoing discourse regarding the use of glycated hemoglobin (HbA1c) as a diagnostic tool for diabetes. The etiological classification of diabetes is now widely acknowledged, identifying type 1 and type 2 diabetes as the primary forms, with type 2 diabetes constituting more than 85% of all cases³⁵.

The ethanolic extract from Rambai peel (EERP) exhibits notable hypoglycemic properties in mice, effectively reducing their blood glucose levels. To produce this extract, Rambai peels underwent immersion in an 85% ethanol solution at a ratio of 1 part peel to 2 parts ethanol. Following immersion, the mixture underwent filtration to eliminate solid residues, and the ethanol was then evaporated to yield a concentrated, thick extract. This process is referred to as the "EERP Preparation" method in the study.

In the experiment, mice were divided into five treatment groups. The first group received distilled water, serving as the control, while the remaining groups were administered EERP at various doses: 200 mg/kg body weight (BW), 400 mg/kg BW, 800 mg/kg BW, and 1600 mg/kg BW. These treatments were administered daily over a period of 14 days. Under normal circumstances, blood glucose levels in mice after overnight fasting typically range between 88 and 112 mg/dl. The study revealed that the average blood glucose levels in the mice decreased progressively with higher doses of EERP. This suggests a dose-dependent hypoglycemic effect of the Rambai peel extract,

demonstrating increased efficacy in reducing blood sugar levels with higher doses³⁶.

Anticancer Activity: Cancer is a complex ailment marked by a range of changes in cellular physiology over time and space, eventually culminating in the formation of malignant tumors. At its core, cancer is characterized by abnormal cell growth, termed neoplasia. The spread of tumor cells to adjacent tissues and distant organs is the primary cause of morbidity and mortality in most cancer patients. Extensive research has been dedicated to comprehending the transformation process from normal cells to malignant cancer cells for several decades. Despite these endeavors, discovering cures or effective long-term management techniques for metastatic cancer remains as formidable a challenge today as it was four decades ago when President Richard Nixon declared a "war on cancer"³⁷. The escalating use of uncontrolled chemicals has led to a notable rise in human illnesses, exacerbated by contemporary lifestyles, stress, and environmental pollution. Researchers worldwide are exploring natural extracts as promising candidates for therapeutic purposes. The World Health Organization (WHO) reports that 80% of individuals in developing nations depend on traditional medicine for their primary healthcare needs³⁸. All four cell lines (MCF-7, DU-145, H460, and HT-29) utilized in this analysis exhibited strong adherence, forming a consistent monolayer on the plastic wells, which is ideal for conducting the MTS assay. The MTS test serves as a straightforward method for the preliminary screening of crude plant extracts and isolated compounds. A direct correlation between cell counts and absorbance at 550 nm was observed for each cell line in both control and drug-treated wells. Following 72 hours of treatment, the anticancer potential of the plant extracts was evaluated. The IC₅₀ values of the plant extracts on MCF-7, HT-29, DU-145, and H460 cell lines were determined using the MTS assay. Moreover, in this investigation, peel extracts of *B. motleyana* exhibited greater potency than fruit extracts on the HT-29 cell line⁷.

Other uses: *Baccaurea motleyana*, commonly referred to as the Rambai tree, originates from Southeast Asia and holds significant cultural, economic, and ecological value. Its fruit, prized for

its sweet and tangy flavor, is savored fresh and incorporated into local cuisines, including preserves, juices, and desserts. Often overlooked, the seeds have potential for oil extraction, enhancing the plant's versatility. The bark serves as a natural dye in traditional fabric coloring, offering an eco-friendly alternative to synthetic dyes, thus preserving local craftsmanship and promoting sustainable practices. In traditional medicine, various parts of *Baccaurea motleyana*, such as the leaves, bark, and roots, are utilized to address diverse ailments, including skin issues and digestive disorders, believed to possess anti-inflammatory and antioxidant properties. Ecologically, the Rambai tree supports biodiversity by providing food for birds and mammals and proves valuable for reforestation and soil conservation due to its adaptability to varied soil conditions. While the wood is not highly durable, it finds utility in crafting small household items and as firewood. These multifaceted uses underscore the Rambai tree's importance in ensuring food security, healthcare, and environmental sustainability in both traditional and contemporary settings.

Additionally, the Rambai tree finds applications in woodcraft, tanning, dyeing, resin production, and other purposes. Notably, the leaves of *Baccaurea motleyana* serve as highly efficient and cost-effective biosorbents for removing mercury (Hg II) from wastewater, with absorption rates reaching up to 95%. Furthermore, these leaves demonstrate proficiency in eliminating cadmium (Cd II) from industrial effluents, boasting a maximum biosorption capacity of 121.95 mg/g³⁹. Under suitable conditions, the stem of the *Baccaurea motleyana* tree can remove up to 51% of nickel ions from aqueous solutions⁴⁰.

Summary: The *Baccaurea* genus, a group of economically valuable plants, is less recognized but widespread across the Old World Tropics, spanning from India to the Pacific. Indigenous communities highly esteem these perennial trees not only for their fruit and timber but also for their medicinal properties, utilizing them to treat ailments like constipation, arthritis, and eye inflammation. *Baccaurea motleyana*, commonly known as Rambai, belongs to the Phyllanthaceae family and thrives in tropical areas such as Kalimantan, Java,

Sumatra, and Malaysia. It adapts well to diverse soil types and altitudes, commonly encountered in both home gardens and rainforests. Various parts of the Rambai tree have traditional medicinal uses, addressing issues like postpartum hemorrhage, gastrointestinal disorders, eye infections, and malaria. With its rich nutritional profile comprising essential vitamins and minerals, coupled with notable antioxidant activity attributed to its phenolic compounds, the plant exhibits antimicrobial, antidiabetic, and potential anticancer properties. Different extraction methods indicate that ethanol extraction yields the highest levels of beneficial phytochemicals such as alkaloids, flavonoids, and tannins.

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