KARYA ILHAM PUBLISHING
CONNECTING MINDS, BRIDGING IDEAS, INSPIRING READERS

Journal of Health and Quality of Life

Journal homepage:
https://karyailham.com.my/index.php/jhqol/index
ISSN: 3030-5101

Health-Promoting Properties of Baccaurea macrocarpa (Tampoi): A Review

Noor Zubaidah Abdul Rahman[1,*], Normala Ahmad[1]

[1] Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA, Cawangan Melaka, Kampus Jasin, 77300 Merlimau, Melaka, Malaysia

ARTICLE INFO

Article history:
Received 1 April 2025
Received in revised form 28 April 2025
Accepted 12 May 2025
Available online 30 June 2025

Keywords:
Fermented Plant Juice (FPJ); sustainable agriculture; organic fertilizer

ABSTRACT

Baccaurea macrocarpa, known locally as Tampoi, is an underutilized tropical fruit with growing interest for its potential health benefits due to its rich phytochemical profile. This review synthesizes available research on the phytochemicals present in B. macrocarpa, including antioxidants like phenolics, flavonoids, and carotenoids, which have shown substantial free radical scavenging activity. The fruit also exhibits antimicrobial, anti-inflammatory, and possible anti-diabetic properties, supporting its use in traditional medicine and hinting at applications for modern therapeutic development. Despite promising findings, studies on B. macrocarpa are limited, particularly regarding its clinical efficacy and safety. This review aims to highlight current knowledge on the bioactive components and health benefits of B. macrocarpa, addressing research gaps and suggesting directions for future studies to further validate its potential as a functional food and nutraceutical.

1. Introduction

Tropical rainforests are home to a vast diversity of plant species, many of which remain underutilized despite their potential health benefits. One such species is Baccaurea macrocarpa, a fruit-bearing plant native to Southeast Asia, including Sumatra, Peninsular Malaysia, Singapore, and Borneo [1]. In Malaysia, it is commonly known as Tampoi, though its name may vary across different regions. In Indonesia, particularly in Kalimantan, numerous Baccaurea species, including B. macrocarpa, can be found and known as Kapul, Jantikan and Kapul Putih [2]. The fruit has a thick orange rind and soft, white, juicy pulp with a sweet-sour taste, resembling that of B. motleyana (Rambai) [3], a closely related species within the same genus.

Traditionally, B. macrocarpa has been consumed fresh or used in local cuisines and its potential medicinal applications have been recognized in some indigenous practices. In Kalimantan, B macrocarpa is traditionally used as a natural remedy for a variety of ailments. Local communities

* *Corresponding author.*
E-mail address: noorzubaidah.nz@gmail.com

https://doi.org/10.37934/jhqol.6.1.3338

utilize it to treat conditions such as menstrual discomfort, abdominal pain, facilitate urination, alleviate arthritis, manage diabetes, reduce hypertension, and relieve constipation. The stem of B. macrocarpa is particularly valued by the Dayak and Banjar ethnic groups, who prepare it by boiling the stem in water and drinking the infusion as a remedy for the flu [4]. These traditional uses highlight the plant's potential as a versatile herbal treatment.

However, despite its promising bioactive properties and cultural significance, B. macrocarpa remains largely underutilized and is not yet cultivated on a commercial scale. Factors such as limited scientific research, lack of large-scale propagation techniques, and low market awareness may contribute to its underutilization.

Hence, this review aims to explore the potential health benefits of B. macrocarpa. By highlighting its nutritional and medicinal value, this study seeks to encourage further research and commercial cultivation, which could help preserve the species, promote sustainable agriculture, and support biodiversity conservation in tropical regions.

1.1 Taxonomic Classification of B. macrocarpa

The scientific classification of *B. macrocarpa* is as follows (Table 1). The Latin name *Baccaurea macrocarpa* is derived from three components: *Bacca*, meaning "berry"; *Aurea*, which refers to its golden color; and *Macrocarpa*, signifying its large fruit size. This species is also known by several synonyms, including *Baccaurea borneensis*, *Baccaurea griffithii*, *Mappa borneensis,* and *Pierardia macrocarpa*.

Table 1
Scientific classification of *B. macrocarpa*

Taxonomic	Classification
Kingdom	Plantae
Clade	Tracheophytes, Angiosperms, Eudicots, Rosids
Order	Malpighiales
Family	Phyllanthaceae
Genus	*Baccaurea*
Species	*Baccaurea macrocarpa*

1.2 Morphological Characteristics of B. macrocarpa

It thrives in lowland forests and can grow up to 15 meters in height. It is a perennial species that can be propagated through seeds. The plant prefers full sun exposure and requires moderate watering for optimal growth. The plant has long-stalked leaves with broad blades reaching up to 36 cm in length and tapering at the base. The leaf color varies from pale green to slightly purple. The yellowish-green flowers grow in clusters along the branches, with female flowers being shorter than male flowers. The mature fruit has a distinct orange-colored skin with a round, apple-like shape, measuring between 2.4 to 6.5 cm in diameter. The fruit grows in clusters, hanging from long strings that can extend up to 20 cm. Each fruit contains three to six large seeds. The outer skin ranges from brownish-orange to deep orange when ripe. The plant is pollinated primarily by insects and its seeds are dispersed by mammals and wind, aiding in natural regeneration.

2. Nutritional Composition

The nutritional composition of *B. macrocarpa* has been examined in several studies, revealing its potential as a nutritious fruit with various beneficial components. The fruit seed of *B. macrocarpa* contains a diverse array of nutrients, including 2.2% fiber, 1.1% fat, 34.6% carbohydrates, 1.5% protein, 61.9% moisture, and 1.5% vitamin C [2]. This composition suggests that the fruit seeds may offer health benefits due to their high carbohydrate content and the presence of vitamin C, which is vital for immune function.

Previous research by Permatasari *et al.,* [5] reported a detailed proximate nutrient composition of the fruit's pulp per 100 g. The pupl provides 127 kcal of energy and is rich in moisture (66.6%), protein (1.5 g), fat (4.4 g), and carbohydrates (27.9 g). It also contains dietary fiber (2.2 g), which contributes to digestive health. In addition to macronutrients, the pulp is a source of essential minerals, such as phosphorus (54 mg), potassium (293 mg), calcium (10 mg), magnesium (20 mg), and iron (20 mg). Notably, it also contains manganese (3 mg), copper (7.3 mg), zinc (18.3 mg), and a small amount of vitamin C (0.1 mg).

These findings suggest that *B. macrocarpa* is a nutrient-dense fruit, with a notable composition of vitamins, minerals, and fiber that may contribute to its medicinal and dietary benefits. The high moisture content of the fruit further highlights its potential for hydration and supporting overall health. Given the nutritional profile, *B. macrocarpa* has promising applications not only as a food source but also in traditional medicine for treating various health conditions. However, additional research is necessary to fully investigate its bioactive properties and evaluate its long-term health benefits.

Nutritional research generally utilized AOAC methodologies for proximate analysis, guaranteeing standardized measurement of macronutrients and minerals. Phytochemical screening frequently employs HPLC and GC-MS to identify chemicals such as flavonoids and phenolics, with discrepancies in reported quantities ascribed to variations in fruit ripeness and extraction solvents. For example, elevated phenolic content observed in the pericarp.

3. Phytochemical Composition

Numerous studies have highlighted the rich phytochemical composition of *B.macrocarpa*, particularly its bark, fruit, and pericarp, which contain various bioactive compounds beneficial for health applications. The bark of *B. macrocarpa* has been found to contain several secondary metabolites, including alkaloids, flavonoids, phenolics, steroids, and triterpenoids, but notably lacks saponins [6]. Many of these compounds, particularly flavonoids and phenolics, exhibit strong antioxidant properties. Similarly, the fruits of *B. macrocarpa* have been reported to contain alkaloids, saponins, and flavonoids [7]. Further analysis of the fruit peel extract revealed significant phytochemical content, including 35% alkaloids, 23% saponins, 2.395 mg of tannins, and 21,000 mg of flavonoids [8]. Across different *Baccaurea* species, several secondary metabolites have been identified, such as anthraquinones, alkaloids, flavonoids, saponins, phenols, and carotenoids, which contribute to their biological activities.

A study by Abu Bakar *et al.,* [9] provided a detailed screening of the phytochemical content in the fruit, reporting total phenolic content (TPC) of 60.04 ± 0.53 mg GAE/g, total flavonoid content (TFC) of 44.68 ± 0.67 mg CE/g, total anthocyanin content (TAC) of 1.23 ± 0.20 mg c-3-gE/100 g, and total carotenoid content (TCC) of 0.81 ± 0.14 mg BCE/g. The distribution of these compounds varied across different fruit parts, with the pericarp containing the highest levels of TPC (60.04 mg GAE/g), TFC (44.68 mg QE/g), TAC (1.23 mg c-3-gE/100g), and TCC (0.81 mg CE/g), while the seeds and flesh had

significantly lower concentrations. Previous study confirmed that the pericarp holds the highest concentrations of phenolics, flavonoids, anthocyanins, and carotenoids, making it the most bioactive part of the fruit [2].

A toxicity test conducted on shrimp larvae demonstrated a dose-dependent effect, where higher concentrations of bark extract led to increased mortality. This suggests that while *B. macrocarpa* possesses beneficial bioactive compounds, its toxicity profile should be further investigated to determine safe consumption levels.

4. Antioxidant Properties

A study by Erwin *et al.,* [6] demonstrated the antioxidant properties of *B. macrocarpa* bark extract using the DPPH method, yielding an IC50 value of 11.15 ppm. This result closely aligns with findings from previous study on the antioxidant activity of the fruit extract [9]. The presence of antioxidants in the bark and fruit of *B. macrocarpa* underscores its potential as a natural source of compounds that help combat oxidative stress.

The reduction of natural antioxidants in the body highlights the importance of supplementing them from external sources to counteract oxidation, particularly when exposed to reactive oxygen species that can contribute to the development of diseases such as cancer, diabetes mellitus, and arthritis. Consuming antioxidant-rich fruits like *B. macrocarpa* is a proactive measure to help mitigate the risks of these conditions. Although in vitro studies and traditional applications indicate *B. macrocarpa's* promise for treating diabetes and hypertension, no clinical trials have validated these effects in humans. Controlled trials are crucial for determining efficacy, appropriate doses, and safety in therapeutic applications.

In addition to antioxidants, *B. macrocarpa* contains a significant amount of methylparaben, a compound widely recognized for its preservative properties [10]. Methylparaben is commonly used in cosmetics, pharmaceuticals, and food products to extend shelf life and prevent microbial growth [11], further enhancing the value of *B. macrocarpa* in both medicinal and commercial applications.

Although in vitro studies and traditional applications indicate *B. macrocarpa's* promise for treating diabetes and hypertension, no clinical trials have validated these effects in humans. Controlled trials are crucial for determining efficacy, appropriate doses, and safety in therapeutic applications.

5. Antibacterial Properties

A study by Norhayati *et al.,* [8] demonstrated that the fruit peel extract of *B. macrocarpa* exhibits antibacterial activity against *Streptococcus sanguis*, a bacterium commonly associated with mouth ulcers. The research was conducted using five different concentrations of the extract: 20%, 40%, 60%, 80%, and 100%. The results indicated that higher extract concentrations led to greater bacterial inhibition. Notably, the 100% extract showed antibacterial efficacy comparable to chlorhexidine, a widely used antiseptic that prevents bacterial growth. This suggests that *B. macrocarpa* has the potential to be developed as a natural remedy for mouth ulcers, gum disease, and sore throats.

The antibacterial properties of *B. macrocarpa* are largely attributed to its high saponin content [12]. Saponins disrupt bacterial growth and development by compromising the integrity of the bacterial cell wall. This interference disturbs bacterial metabolism, leading to intracellular leakage, increased cell permeability, and ultimately, bacterial cell death [13].

Additionally, the presence of alkaloids in *B. macrocarpa* contributes to its antibacterial activity. Alkaloids inhibit the synthesis of peptidoglycan, a crucial component of bacterial cell walls [14]. This disruption prevents proper cell wall formation, leading to bacterial necrosis and eventual cell death.

Tannins also play a role in inhibiting bacterial growth by binding to proteins, which are essential for cell wall formation [15]. This disruption affects the integrity of the bacterial cell wall, making it more susceptible to damage. Once the cell wall is compromised by both flavonoids and saponins, cell lysis occurs, allowing tannins to be more easily absorbed into the bacterial cell, where they coagulate the protoplasm. Additionally, tannins exhibit toxicity by forming complex bonds with metal ions, leading to bacterial cell damage.

Moreover, the leaf extract of *Baccaurea macrocarpa* has been reported to exhibit antibacterial properties. A study by Zamzani *et al.,* [16] along with similar findings by previous study revealed that the ethyl acetate fraction of the leaf extract effectively inhibited the growth of *Escherichia coli* and *Bacillus cereus* [17]. However, no antibacterial activity was observed with the ethanol extract, while the n-hexane fraction demonstrated antibacterial effects solely against *B. cereus*. This could be due to the higher concentration of secondary metabolites, particularly flavonoids and phenolic acid compounds, in the ethyl acetate extract.

6. Antileukemic Properties

A one-week maceration of 1 kg of *B. macrocarpa* extract, as reported by Pardede *et al.,* [7], was tested for antileukemic bioactivity on Human Leukemia (HL-60) cells. The results showed that only 22% of the cells remained viable, indicating a 78% mortality rate. Further studies are needed to confirm the bioactivity of the extract and its potential to assist individuals with chronic diseases.

7. Antiviral Properties

Flavonoids possess antiviral and anti-inflammatory properties [18]. They have the potential to disrupt the viral cell membrane, causing intracellular fluid to leak out of the bacteria or virus. Additionally, flavonoids can inhibit the synthesis of DNA-RNA hydrogen bonds, preventing viral replication [18].

8. Conclusions

The phytochemical richness of *B. macrocarpa* highlights its potential as a valuable source of natural antioxidants and antibacterial agents. The high concentrations of phenolics, flavonoids, anthocyanins, and carotenoids in the pericarp suggest promising applications in nutraceutical, pharmaceutical, and cosmetic industries.

Future research must focus on essential deficiencies, such as human clinical trials to validate health benefits, thorough toxicity assessments to guarantee safety, and mechanistic investigations to clarify the impacts of chemicals like flavonoids.

Acknowledgement
This research was not funded by any grant.

References
[1] Chan, P. J., W. N. Lam, Y. Y. Ting, A. Phang, R. Chong, N. E. Rahman, and K. Y. Chong. "Towards a field guide to the trees of the nee soon swamp forest (VIII): Sapotaceae." *Nat Singap Supplement* 1 (2022): e2022074.

[2] Astuti, M. D., W. F. Ana, and K. Rosyidah. "The antioxidant activity of white kapul (Baccaurea macrocarpa) fruit rinds." In *IOP Conference Series: Materials Science and Engineering*, vol. 980, no. 1, p. 012040. IOP Publishing, 2020. https://doi.org/10.1088/1757-899X/980/1/012040

[3] Sofiyanti, Nery, Fitmawati Fitmawati, Mayta Novaliza Isda, Asih Rahayu Ajeng Agesti, Maya Sari, and Syafroni Pranata. "Baccaurea Lour.(Phyllanthaceae Martinov-Malpighiales), underutilized plant from Riau, Indonesia and its phytochemical study." *Biodiversitas Journal of Biological Diversity* 23, no. 2 (2022). https://doi.org/10.13057/biodiv/d230236

[4] Hikmah, Nor, and Gunawan Gunawan. "Etnobotani Kapul (Baccaurea Macrocarpa) Dan Limpasu (Baccaurea Lanceolata) Oleh Suku Dayak Dan Suku Banjar Di Kabupaten Hulu Sungai Selatan Dan Hulu Sungai Tengah." *Bioscientiae* 19, No. 2 (2022). https://doi.org/10.20527/b.v19i2.6593

[5] Permatasari, Lina, Sugeng Riyanto, and Abdul Rohman. "Genus of Baccaurea: Extraction Method, Secondary Metabolites and Its Biological Activities." *International Journal of Pharmaceutical Research (09752366)* 13, no. 1 (2021). https://doi.org/10.31838/ijpr/2021.13.01.013

[6] Erwin, Erwin, Widar Ristiyani Pusparohmana, Indah Permata Sari, Rita Hairani, and Usman Usman. "GC-MS profiling and DPPH radical scavenging activity of the bark of Tampoi (Baccaurea macrocarpa)." *F1000Research* 7 (2019): 1977. https://doi.org/10.12688/f1000research.16643.2

[7] Pardede, Antoni, Rr Ariessanty Alicia Kusuma Wardhani, and Emilda Frasisca. "Antileukemic Activity of Methanol Extract From Stem of Baccaurea macrocarpa, Syzygium jambos, Bouea macrophylla Griff., and Diospyros discolor Willd." *EduChemia: Jurnal Kimia dan Pendidikan* 5, no. 2 (2020): 111-118. https://doi.org/10.30870/educhemia.v5i2.8320

[8] Norhayati, Norhayati, Siti Ujrumiah, Annisa Noviany, and Amy Nindia Carabelly. "Antibacterial potential of kapul fruit skin (Baccaurea macrocarpa) on Streptococcus sanguis." *ODONTO: Dental Journal* 6, no. 2 (2019): 118-124. https://doi.org/10.30659/odj.6.2.118-124

[9] Abu Bakar, Mohd Fadzelly, Nor Ezani Ahmad, Fifilyana Abdul Karim, and Syazlina Saib. "Phytochemicals and antioxidative properties of borneo indigenous liposu (Baccaurea lanceolata) and tampoi (Baccaurea macrocarpa) fruits." *Antioxidants* 3, no. 3 (2014): 516-525. https://doi.org/10.3390/antiox3030516

[10] Tanuwidjaja, Teguh. "Development of Anti-Aging Cream Preparations with Active Substances from Plant Extracts: Physicochemical Review and Potential Applications." *Jurnal eduhealth* 14, no. 03 (2023): 1310-1325. https://doi.org/10.54209/jurnaleduhealth.v14i3.2522

[11] Roy, Souvik, Saheli Majumder, Aniket Deb, and Lopamudra Choudhury. "Microbial contamination of cosmetics and the pharmaceutical products, and their preservation strategies: A comprehensive review." *Novel Research in Microbiology Journal* 7, no. 5 (2023): 2116-2137. https://doi.org/10.21608/nrmj.2023.317346

[12] Erwin, Erwin, Widar Ristiyani Pusparohmana, Indah Permata Sari, Rita Hairani, and Usman Usman. "GC-MS profiling and DPPH radical scavenging activity of the bark of Tampoi (Baccaurea macrocarpa)." *F1000Research* 7 (2019): 1977. https://doi.org/10.12688/f1000research.16643.2

[13] Chen, Weicheng, Peng Zhang, Yucui Ding, Xiaobin Xie, Jianlong Fu, Rong Zhao, Yihan Xiao et al. "Bioactives from biomass: Treasure for future potent antimicrobial applications." *Chemical Engineering Journal* (2024): 155669. https://doi.org/10.1016/j.cej.2024.155669

[14] Zhou, Jingxuan, Yi Cai, Ying Liu, Haoyue An, Kaihong Deng, Muhammad Awais Ashraf, Lili Zou, and Jun Wang. "Breaking down the cell wall: Still an attractive antibacterial strategy." *Frontiers in Microbiology* 13 (2022): 952633. https://doi.org/10.3389/fmicb.2022.952633

[15] Huang, Jianzi, Madiha Zaynab, Yasir Sharif, Jallat Khan, Rashid Al-Yahyai, Monther Sadder, Munawar Ali, Saqer S. Alotaibi, and Shuangfei Li. "Tannins as antimicrobial agents: Understanding toxic effects on pathogens." *Toxicon* (2024): 107812. https://doi.org/10.1016/j.toxicon.2024.107812

[16] Zamzani, Irfan, and Nita Triadisti. "Antibacterial Activity of Extract and Fraction of Baccaurea macrocarpa Leaf on Escherichia coli and Bacillus cereus." *Proceeding ISETH (International Summit on Science, Technology, and Humanity)* (2019): 551-556.

[17] Rahmadani, Rahmadani, Risa Supriningrum, and Hayatus Sa'adah. "Total Flavonoid Content Of Kapul Fruit Peel Extract (Baccaurea Macrocarpa) Based On Solvent Type Variation Using Uv-Vis Spectrophotometry." *Al Ulum: Jurnal Sains Dan Teknologi* 10, No. 3 (2024): 91-97. https://doi.org/10.31602/jst.v10i3.16642

[18] Ninfali, Paolino, Antonella Antonelli, Mauro Magnani, and Emanuele Salvatore Scarpa. "Antiviral properties of flavonoids and delivery strategies." *Nutrients* 12, no. 9 (2020): 2534. https://doi.org/10.3390/nu12092534