Journal of Ethnopharmacology and Toxicology
Research Article

Nutritional potential of the leaves and fruits of *Macaranga peltata* (Roxb.) Mull. Arg.

Remya Krishnan*, Sandra Sreekumar, Anjali B. S., Krishnendu A.P., Sandeep S., Aparna A., Anjana M.S., Amal Krishna M.

Post Graduate Department of Botany & Research Center, Mahatma Gandhi College, Thiruvananthapuram, Kerala, India.

***Correspondence**
Remya Krishnan
drrkbotany2020@gmail.com

Volume: 3, Issue: 1, Pages: 42-51
DOI: https://doi.org/10.37446/jet/rsa/3.1.2025.42-51
Received: 12 December 2024 / Accepted: 29 March 2025 / Published: 30 June 2025

Wild edible plants play an essential role in enhancing diets, particularly in developing nations. *Macaranga peltata*, a member of the Euphorbiaceae family and one of the 300 species within the genus *Macaranga*, has significant culinary and medicinal value. Traditionally, it has been utilized to address various health conditions such as fever, headaches, stomach disorders, and skin issues. Research highlights its potent antioxidant and anti-cancer properties. The leaves of *Macaranga peltata* are versatile, often cooked or steamed for consumption as a vegetable, while also finding applications in various culinary preparations. Meanwhile, the fruits are underutilized in Kerala. Even though, *M. peltata* has several culinary uses, scientific validation regarding the proximal composition is not available. In this context, the present study aims to analyse and compare the nutritive and anti-nutritive potentiality of *Macaranga peltata* (Roxb.) fruits and leaves. Proximate composition of *M. peltata* leaves and fruits were analyzed in terms of Moisture, ash content, fibre content, amino acid, protein, carbohydrate, vitamins, phenol, tannin and phytic acid using standard protocols. The results showed that the leaves and fruits contain appreciable amount of the basic food nutrients such as protein, amino acid, carbohydrates, vitamins and fiber. Anti-nutritional factors like tannin and phytic acid were below the tolerable value. From the results it can be concluded that *M. peltata* leaves and fruits can supply substantial amount of the required daily intake. Integrating modern processing techniques such as drying, fermentation, and extraction methods with traditional knowledge has the potential to establish a strong foundation for the commercial utilization of this plant. This approach could facilitate the development of innovative food products and broaden its applications in the pharmaceutical sector.

Keywords: *amino acid, ash, carbohydrate, fibre, Macaranga, nutrition, phenol, phytic acid, protein, tannin, vitamins*

Introduction

Wild edible plants have historically been a vital part of human sustenance, particularly in promoting food security. The Euphorbiaceae family, one of the largest families of flowering plants, encompasses 218 genera and approximately 5,735 species (Zixi et al., 2016). Many species in this family are recognized for their applications in traditional medicine and skincare (Zahidin et al., 2017). For instance, fresh or dried leaves from certain *Macaranga* species have been employed by traditional healers to address issues such as swelling, cuts, sores, boils, and bruises (Sree Lakshmi et al., 2025; Thanh et al., 2012; Zakaria et al., 2012). *Macaranga* is the largest genus in the Euphorbiaceae family, with approximately 300 species found mainly in the tropics of Africa, Southeast Asia, Australia, and the South Pacific region (Joseph, 2014). *Macaranga peltata*, a species native to northern Thailand, Sri Lanka, and India, is one of the most common early-successional woody plants in Sri Lanka's lowland wet zone and is locally known as Vattakanni in Kerala. Recent research has highlighted the high nutritional value of underutilized wild edible plants, such as *Macaranga peltata*, which are often used in various cuisines to flavour or complement other dishes. However, much of the traditional knowledge surrounding these plants is at risk of being lost as it is preserved primarily in the memories of the elders

(Sree Lakshmi et al., 2025). *Macaranga peltata* has been traditionally recognized for its medicinal applications, including the treatment of fever, headaches, stomach ailments, and skin conditions. Scientific investigations have highlighted its notable antioxidant and anti-cancer properties. In the state of Kerala, the leaves of *M. peltata* are widely consumed as a vegetable after boiling or steaming, though its fruits remain largely unexploited. The present study focuses on evaluating and contrasting the nutritional and anti-nutritional properties of the leaves and fruits of *Macaranga peltata* (Roxb.), aiming to uncover their potential applications.

Materials and Methods

Plant material selected for the study is leaves and fruits of *Macaranga peltata (*Roxb.) Mull. Arg. collected from Thiruvananthapuram District, Kerala (Fig. 1a &b). *Macaranga peltata* is a small tree with stout, smooth, and finely furfuraceous twigs up to 1 cm in diameter. The stipules are ovate or oblong, acute at the apex, rusty furfuraceous and soon caducous. The leaves have slender petioles that are weakly furfuraceous and slightly striate. The ovate leaf is thickly papery, with a broadly rounded and deeply peltate base. It has nectaries near the basal margin and towards the apex, an entire margin, and an acute apex with a possible narrow acumen. The lower surface is weakly pubescent with short white tufted hairs and palmately nerved. Staminate flowers, occurring in clusters, are shortly pedicellate with free, pubescent sepals and three stamens. Pistillate inflorescences are similar but shorter. Pistillate flowers have a vestigial calyx, a granular glandular ovary, and a large papillose lateral stigma. The fruits occur in groups of up to three, are unilocular (rarely bilocular). They are thinly woody and granular glandular, with a slender furfuraceous pedicel, a tiny persistent calyx, and small sub-basal plate-like papillose stigmas.

Figure 1. a. Plant Material - *Macaranga Peltata* (Roxb.) Mull. Arg., b- Fruits

Methodologies

For the nutritional composition analysis of *Macaranga peltata* leaves and fruits, both fresh and dried materials were used as appropriate, following standard methodologies. Moisture content was determined using the protocols established by the Association of Official Analytical Chemists (A.O.A.C.). A 10g leaf sample was weighed in a petri dish and dried in an oven at 60±2°C for 7–8 hours. After cooling, the final weight of the sample was recorded. Ash content was analyzed by incinerating a 2g sample in a muffle furnace at 500°C for 6 hours until the ash turned white, following the A.O.A.C. (2005) guidelines. Fiber content was determined using the method described by Nandi et al. (2016). A 2g air-dried powdered leaf sample was first defatted using petroleum ether. It was then treated with 200ml of sulfuric acid and bumping chips for 30 minutes, followed by filtration and washing with distilled water. The residue was subsequently boiled for 30 minutes with 200ml of sodium hydroxide solution, transferred to a pre-weighed crucible (W1), dried at 120ºC for 2 hours, and finally weighed (W2).

Total free amino acids were quantified using the ninhydrin reagent method (Darwish et al.). A 1 ml methanolic extract was mixed with 5 ml of ninhydrin reagent, shaken well, and boiled for 10 minutes. The absorbance was recorded at 570 nm. Protein content was estimated using the Bradford method (Doğan et al., 2005). A 30 µl sample was mixed with 70 µl of distilled water, followed by the addition of 2.9 ml of Coomassie Brilliant Blue solution. The mixture was thoroughly mixed, incubated for 5 minutes at room temperature, and the absorbance was recorded at 595 nm against a reagent blank. All analyses were performed in triplicates.The reducing sugar content was determined using the 3,5-dinitrosalicylic acid (DNSA) method, following the procedure of Krivorotova and Sereikaite (2014) with slight modifications.

Vitamin content in fruits and leaves were estimated using standard spectrophotometric procedures. For ascorbic acid (Vitamin C)-A 100 g tissue sample was ground with 10 ml of distilled water, and the liquid extract was decanted into a 100 ml volumetric flask. The extracted solution was made up to 100 ml with distilled water. A 20 ml aliquot of the sample solution was transferred to a 250 ml conical flask, followed by the addition of 150 ml distilled water and 1 ml starch indicator solution. The sample was titrated with 0.005 mol L^{-1} iodine solution until a dark blue-black color appeared, indicating the endpoint due to the starch-iodine complex. Titration was repeated to obtain concordant values (Dinesh et al., 2015). Tocopherol/ (Vitamin E), content was estimated using the IUPAC method. A 1 g fruit tissue sample was refluxed in an ascorbic acid and ethanol mixture for 3–5 minutes. Then, 1 ml of potassium hydroxide and water mixture was added and boiled for 3 minutes. The mixture was cooled, 25 ml of distilled water was added, and the solution was transferred to a separating funnel. After adding 50 ml of diethyl ether and shaking for 1 minute, the lower aqueous layer was collected and washed three times with ether. The tocopherol extract in the ether layer was washed with distilled water until alkali-free. The ether layer was removed, and the residue was redissolved in a benzene-ethanol mixture and evaporated. The dry extract was dissolved in 1 ml of hexane, evaporated again, and finally dissolved in 4 ml of ethanol. The absorbance was measured at 292 nm, and the tocopherol content was determined using a standard α-tocopherol curve. A 1 g sample was placed in a stoppered conical flask with 20 ml of 60% potassium hydroxide and kept in the dark for 3 hours for saponification. The mixture was transferred to a separating funnel and washed with petroleum ether. The ether layer was collected and washed six times until it became alkali-free. The ether layer containing β-carotene was combined, made up to a known volume, and the absorbance was recorded at 429 nm using petroleum ether as a blank (Stephen & Chibuzo, 2017).

Anti-nutritional factors were evaluated, The tannin content was measured using the method described by Irakli et al. (2020). Phytic acid content was determined by the ferric precipitation method, where the sample was treated with a ferric chloride solution, and the formation of the ferric phytate complex was measured spectrophotometrically and the total soluble phenolic content was determined spectrophotometrically using the Folin–Ciocalteu method, as outlined by Mattila et al. (2018).

Results

Phytonutrients, which are naturally occurring chemical compounds in plants, represent non-nutritive secondary metabolites distributed across various plant parts. These compounds have garnered significant scientific attention due to their diverse biological activities and potential health benefits. Additionally, the proximate composition of plant materials—including protein, fat, carbohydrate, fiber, ash, moisture, and dry matter content—is crucial for determining their nutritional value and potential as food sources. The proximate composition screening results of *M. peltata* leaves and fruits are given in the table 1.

Table 1. Proximate (dietary component) composition of *M. peltata* leaves and fruits

Proximate (dietary component) composition	Leaves	Fruits
Moisture	82±3 %	87±2 %
Ash content	5.64±1%	12.3±1.5 %
Fibre content	3.6±0.5 mg/g	2.3±0.5 mg/g
Amino acid	10.54±1 mg/g	16.22±1 mg/g
Protein	18.3±2 mg/g	16.6±1.5 mg/g
Carbohydrate	34.8±2 mg/g	26.5±2 mg/g
Vitamin A	17.65±1 mg/100g	36.22±1 mg/100g
Vitamin C	56.74±3 mg/100g	67.47±2 mg/100g
Vitamin E	29.6±2 mg/ 100g	48.6±1 mg/ 100g
Phenol	2.36 ±0.4mg/g	3.44±0.5 mg/g
Tannin	3.2±0.2 µg/g	5.4±0.2 µg/g
Phytic acid	0.8±0.05 µg/g	1.98±0.05 µg/g

The proximate composition of the plant parts, as shown in the table, indicates that both the leaves and fruits of *Macaranga peltata* contain significant amounts of essential nutrients, such as protein, amino acids, carbohydrates, and fiber. The vitamin content also follows a similar pattern, with both the leaves and fruits contributing a substantial portion of the daily required intake. The proximate composition of *Macaranga peltata* leaves and fruits reveals their rich nutritional and functional properties. The fruits have a higher moisture content (87±2 %) compared to leaves (82±3 %), making them juicier but more perishable. Both are rich in proteins, carbohydrates, vitamins, and antioxidants, with leaves slightly leading in protein (18.3±2 mg/g) and carbohydrates (34.8±2 mg/g), while fruits have higher amino acids (16.22±1 mg/g) and vitamins, including Vitamin A (36.22±1 mg/100g), Vitamin C (67.47±2 mg/100g), and Vitamin E (48.6±1 mg/100g). The leaves contain more fiber (3.6±0.5 mg/g), beneficial for digestion, whereas fruits have elevated phenol (3.44 mg/g) and tannin (5.4 µg/g) levels, enhancing antioxidant activity despite minor antinutritional effects. Phytic acid content is low in both, slightly higher in fruits (1.98±0.05 µg/g). The results indicate significant variations between the leaves and fruits in terms of nutritional and phytonutrient composition, with fruits generally having higher concentrations of ash, vitamins, and antinutrients.

Discussion

The moisture content of food is a key indicator of its water composition, significantly impacting its quality prior to consumption. It influences various physical and chemical properties, such as freshness, texture, and stability during storage. Variations in moisture levels among fruits are determined by their specific physiological traits and external factors like environmental humidity, temperature, and the timing of harvest (Islary et al., 2016; Chen et al., 2024). Similar studies by Mann et al. (2016) and Kumari & Dhingra (2024) have highlighted the differences in moisture content across various fruit crops, emphasizing its role in post-harvest management. In present study the fruits have a higher moisture content (87±2 %) compared to the leaves (82±3 %), indicating that fruits are more hydrating but also more perishable. Fruits of *Macaranga* show a higher ash content (12.3±1.5 %) than leaves (5.64%), which could indicate a greater mineral content in the fruits. Assessing the ash content in food is equally essential, primarily for nutritional analysis. Ash content reflects the total mineral composition in food. Although minerals typically account for less than 7% of the dry matter, they are critical due to their physicochemical, technological, and nutritional roles (John et al., 2025; Justesen & Knuthsen, 2011). For instance, the wild fruits of *C. hardwickii* demonstrated a high ash content of 16.87 ± 1.35%, suggesting these fruits are rich in minerals and capable of significantly contributing to dietary mineral intake (Justesen & Knuthsen, 2011). Vegetables are an excellent source of dietary fiber, which is vital for reducing the risk of various health conditions, including obesity, diabetes, constipation, high cholesterol, heart diseases, colon cancer, and hypertension. The World Health Organization (WHO) recommends consuming 22–23 grams of dietary fiber per 1000 kcal of daily intake to support proper digestion and waste elimination. High-fiber diets are essential for maintaining gut health and are a cornerstone of balanced human nutrition (Ioniță-Mîndrican et al., 2022, Biscarrat et al., 2024). The findings of this study align with prior research. Rai et al. (2005) and Sundriyal and Sundriyal (2003) reported similar crude fiber content in their analyses, while Mann et al. (2016) highlighted comparable dietary fiber levels in *Baccaurea sapinda* pulp. Ibrahim et al. (2013) documented even higher total dietary fiber levels (6.3%) in freeze-dried *B. angulata* fruits. Fiber-rich fruits and vegetables have been shown to enhance the absorption of trace elements in the gut and reduce cholesterol absorption (Le Ville & Suberlich, 1966). Dietary fiber contributes significantly to healthy nutrition by improving bowel function through its effects on intestinal viscosity, water retention, and microbial composition, facilitating smoother digestion (Elleuch et al., 2011). In this study the leaves contain more fiber (3.6 ± 0.5 mg/g), which is beneficial for digestion, whereas the fruits have lower fiber (2.3 ± 0.5 mg/g). Fiber consumption also aids in weight management and reduces the risk of numerous diseases (Waddell & Orfila, 2022). Furthermore, it improves glucose tolerance, supports heart health, and alleviates conditions such as constipation and hemorrhoids (Akbar & Shreenath, 2023). Common fruits and vegetables like apples (3.2% fiber), broad beans (8.9%), cabbage (2.8%), potatoes (1.7%), and spinach (2.5%) provide varied amounts of dietary fiber (Sundriyal & Sundriyal, 2003). The results of this study indicate that the plant materials investigated can help fulfill the WHO's daily dietary fiber recommendations, highlighting their potential health benefits and nutritional significance.

Carbohydrates, including starch, glucose, sucrose, and lactose, are primary energy sources in fruits and vegetables. Research on wild fruits from various regions within and beyond India has consistently highlighted their significant carbohydrate content (Rajalakshmi et al., 2017; Sudhakaran & Nair, 2016; Nayak & Basak, 2015; Saha et al., 2014). The findings of this study align with previously documented carbohydrate levels in wild edible vegetables such as bitter gourd (10.6%), beans (29.1%), and jackfruit seeds (25.8%), suggesting that the fruits of *Macaranga peltata* could serve as a rich carbohydrate source for human consumption. However, the leaves of *Macaranga* have a higher carbohydrate content (34.8 ± 2 mg/g) compared to the fruits (26.5 ± 2 mg/g), which contributes to their energy value. The concentration of amino acids in body fluids can fluctuate significantly due to dietary habits or underlying health conditions. The body's capacity to retain specific amino acids at minimal intake levels varies widely, and the dietary requirement for amino acids does not precisely match the composition of proteins within the body. Among the essential amino acids, leucine plays a pivotal role in multiple physiological processes, such as muscle repair, blood clotting, hormone production, blood sugar regulation, and energy supply. Leucine's importance in enhancing endurance and providing energy underscores the health benefits associated with its presence in *Macaranga peltata* (Gold, 2009, Pedroso et al., 2015). While both the leaves and fruits of *Macaranga* provide essential amino acids, the fruits contain a higher amount of amino acids (16.22 ± 1 mg/g) compared to the leaves (10.54 ± 1 mg/g). However, the leaves have slightly more protein (18.3 ± 2 mg/g) than the fruits (16.6 ± 1.5 mg/g). Proteins are critical for numerous physiological functions, including enzyme synthesis, hormonal regulation, tissue repair, and immune system maintenance (Zhong et al., 2023). Common sources of dietary protein include legumes, nuts, and seeds. The protein content in this study is consistent with previous findings by Rai et al. (2005) and Sundriyal & Sundriyal (2003), although differences may arise due to variations in agro-climatic conditions and other environmental factors. Studies on lesser-known or wild edible fruits have similarly reported significant protein content (Yiblet, 2024; Mahapatra et al., 2012; Murugkar & Subbulakshmi, 2005; Sabir & Riaz, 2005; Aberoumand, 2008; Desai et al., 2010; Deshmukh & Waghmode, 2011). While the protein content of *M. peltata* fruits is somewhat lower than that of wild leafy vegetables like *Momordica balsamina*, *Carpesium cernuum*, *Eurya acuminata*, and *Ardisia humilis* (Hassan & Umar, 2006), it still highlights their potential as protective food supplements. Plant foods with a caloric protein contribution exceeding 12% are generally recognized as good protein sources. The overall energy value of foods is determined by analyzing the protein, fat, and carbohydrate content and applying respective conversion factors, thereby highlighting their comprehensive nutritional contributions.

Additionally, this study evaluated the vitamin composition of *M. peltata*, particularly focusing on vitamins A, C, and E. Vitamin C, a crucial antioxidant, is vital for overall health, aiding in the prevention of infections and maintaining the health of skin, gums, and blood vessels (Ngurthankhumi et al., 2024). Its deficiency can result in symptoms like bruising, bleeding, dry skin, and mood-related issues such as depression. Previous research has indicated that wild fruits often contain notable levels of ascorbic acid, with values ranging from 0.7 to 32.0 mg per 100 g (Bhutia, 2013). The findings of this study reveal that *M. peltata* fruits and leaves are rich in vitamin C, which may help in preventing scurvy and other conditions associated with vitamin C deficiency. The fruits of *Macaranga* show higher concentrations of vitamins, including Vitamin A (36.22 ± 1 mg/100g), Vitamin C (67.47 ± 2 mg/100g), and Vitamin E (48.6 ± 1 mg/100g), making them a richer source of these essential nutrients compared to the leaves, which contain Vitamin A (17.65 ± 1 mg/100g), Vitamin C (56.74 ± 3 mg/100g), and Vitamin E (29.6 ± 2 mg/100g). Ascorbic acid serves as a powerful antioxidant, protecting the body against oxidative stress and commonly utilized as a food preservative to inhibit oxidation (Padayatty et al., 2003; Agwu et al., 2024). Regular consumption of fruits high in ascorbic acid, like *Macaranga peltata*, offers significant health benefits, such as reducing the risks of cardiovascular disease, stroke, and cancer (Willett, 2002). Encouraging the intake of *M. peltata* could play a vital role in improving the nutritional status of local populations, addressing vitamin C deficiencies, and promoting overall well-being. Vitamin E, a fat-soluble nutrient and another potent antioxidant, is recognized for its contribution to reducing cardiovascular and blood-related disorders (Rychter et al., 2022; Lako et al., 2007). Analyses of underutilized fruit species have shown Vitamin E levels ranging from 2.10 ± 0.14 IU to 47.40 ± 1.10 IU, with *M. edulis* exhibiting the highest levels. Species such as *Eleocarpus sikkimensis*, *Spondias axillaris*, and *Baccaurea sapinda* have also demonstrated significant Vitamin E content. Although research on Vitamin E in lesser-known fruits remains limited, these findings highlight their potential as dietary sources of this nutrient, which could contribute to cardiovascular health.

Vitamin A, another crucial fat-soluble vitamin, is essential for human health, particularly in regions like India, where deficiency is prevalent (Song at al., 2023). Vitamin A supports key biological functions, including cell division, bone and tooth development, and maintaining healthy skin and hair (Rajalakshmi et al., 2017; Sudhakaran and Nair, 2016; Hazali et al., 2015). The fruits analyzed in this study were found to be rich in Vitamin A, making them valuable as a dietary supplement to address conditions like low vision, weakened immunity, and inflammatory diseases. These fruits offer an affordable and locally available option to combat Vitamin A deficiency effectively. Polyphenols play a significant role in determining the quality attributes of fruits, including their color, taste, and nutritional value (Liu et al., 2024; Cheynier, 2005). Epidemiological evidence has shown a strong association between polyphenols and a lower risk of cancer cell development (Sejbuk et al., 2024; Potter, 2005). In the current study, a notable variation in total phenol content was observed across different fruit species. For example, methanol extracts from *Spondias axillaris* exhibited a significantly higher concentration of phenolic compounds, recorded at 71.83 ± 0.42 mg of gallic acid equivalent (GAE), while the lowest concentration was observed in *Macaranga edulis*, with only 11.17 ± 0.06 mg GAE g^{-1}. This variation in phenolic content can be attributed to factors such as soil composition, irrigation methods, environmental stress, and other agro-climatic conditions. The *M. peltata* fruits have higher levels of phenols (3.44 ± 0.5 mg/g) and tannins (5.4 ± 0.2 µg/g), contributing to their antioxidant properties. Though beneficial for antioxidant activity, these compounds also have antinutritional effects when consumed in excess. These results are consistent with earlier research by Singh et al. (2014), which noted similar fluctuations in phenolic content in underutilized fruit species. The presence of polyphenols in fruits is closely linked to their antioxidant capacity, highlighting their crucial role in mitigating the risk of various life-threatening diseases, including cancer, neurological disorders, and cardiovascular diseases, through their antioxidant effects. As such, fruits rich in polyphenols may serve as valuable dietary elements for supporting health and preventing chronic diseases.

The study also examined antinutrient levels, including condensed tannins and phytic acid. Condensed tannins are known to disrupt nutrient digestion and may interfere with the absorption of beneficial compounds in the body (Molino et al., 2023). Phytic acid, which has been criticized for its ability to bind essential minerals like iron, zinc, calcium, and magnesium, reduces their bioavailability, potentially limiting their absorption. The phytic acid levels identified in this study are shown in Table 1, with the amounts in cabbage, Ethiopian kale, and Swiss chard falling below the tolerable threshold of 200 mg, as reported by Hurrell (2004). The phytic acid content is low in both parts of *M. peltata* with slightly higher levels in the fruits (1.98 ± 0.05 μg/g) compared to the leaves (0.8 ± 0.05 μg/g). This compound, while low, may influence mineral absorption.

Despite the presence of these antinutrients, the findings suggest that consuming *Macaranga peltata* leaves and fruits can provide essential nutrients that support healthy bodily functions. Furthermore, these parts of the plant serve as antioxidants, helping protect the body from the damaging effects of reactive oxygen species (ROS) and preventing lipid peroxidation. As such, *M. peltata* can be considered a valuable food source, offering both nutritional and protective health benefits.

Conclusion

In conclusion, the analysis of *Macaranga peltata* leaves and fruits reveals their significant nutritional value and health benefits. The studied fruits and leaves are rich in essential nutrients, including dietary fiber, carbohydrates, proteins, vitamins (A, C, and E), and polyphenols, making them valuable additions to the human diet. These nutrients contribute to improved glucose tolerance, enhanced immune function, and the prevention of lifestyle-related diseases, including cardiovascular issues and certain cancers. Furthermore, the antioxidant potential of these fruits and leaves, primarily due to their polyphenol and vitamin content, supports their role in mitigating oxidative stress and preventing lipid peroxidation. While antinutrients like condensed tannins and phytic acid were detected, the levels of these compounds were within acceptable limits, suggesting that their negative effects on nutrient absorption are minimal. Moreover, the low levels of these antinutrients further emphasize the potential of *Macaranga peltata* as a nutritious and functional food source. Overall, *Macaranga peltata* holds great potential as a nutritious and protective food source, capable of addressing vitamin deficiencies and supporting overall health, particularly in regions with limited access to other dietary supplements. If used in the food industry, it might pave the way for healthier snacks, supplements, or functional foods that support overall well-being and help prevent diseases. Its combination of essential nutrients and antioxidant properties positions it as a promising candidate for further research and potential commercial utilization in both food and pharmaceutical sectors. The integration of traditional knowledge with modern processing techniques could pave the way for innovative product development and the widespread adoption of this plant as a sustainable food resource.

Acknowledgment

NIL.

Author contributions

Remya Krishnan – Study design, validation, supervision supervised and approved the final version, Sandra Sreekumar Anjali B. S, Krishnendu A.P., Sandeep S., Aparna A, Anjana M.S. and Amal Krishna M- investigation, data collection, formal analysis and writing.

Funding

NIL.

Ethics approval

Not applicable.

Competing Interests

The authors declare no conflict of interest. The manuscript has not been submitted for publication in another journal.

AI Tool Declaration

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

References

Aberoumand, A. (2008). Comparison of protein values from seven wild edible plants of Iran. *African Journal of Food Science*, *2*, 073–076.

Agwu, E., Ezihe, C., & Kaigama, G. (2024). Antioxidant Roles/Functions of Ascorbic Acid (Vitamin C). Intech Open. doi: 10.5772/intechopen.110589

Akbar, A., & Shreenath, A. P. (2023). High fiber diet. In Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2025 Jan–. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559033/.

AOAC. (2005). *Methods for proximate analysis*. Association of Official and Analytical Chemists. pp. 2217–2280.

Biscarrat, P., Bedu-Ferrari, C., Langella, P., & Cherbuy, C. (2024). Pulses: A way to encourage sustainable fiber consumption. Trends in Food Science & Technology, 143, 104281. https://doi.org/10.1016/j.tifs.2023.104281.

Bhutia, K. D. (2013). Studies on the physicochemical characteristics and utilization aspects of some indigenous minor fruits of Sikkim. (Doctoral dissertation). Department of Pomology and Post-Harvest Technology, Uttar Banga Krishi Vishwa Vidyalaya. pp. 203.

Chen, N., Wei, W., Yang, Y., Chen, L., Shan, W., Chen, J., & Wu, C. (2024). Postharvest physiology and handling of guava fruit. *Foods*, *13*(805).

Cheynier, V. (2005). Polyphenols in foods are more complex than often thought. *American Journal of Clinical Nutrition*, *81*, 223S–229S.

Darwish, W. S., Khadr, A. E. S., Kamel, M. A. E. N., Abd Eldaim, M. A., El Sayed, I. E. T., Abdel-Bary, H. M., Ullah, S., & Ghareeb, D. A. (2021). Phytochemical Characterization and Evaluation of Biological Activities of Egyptian Carob Pods (*Ceratonia siliqua* L.) Aqueous Extract: In Vitro Study. *Plants*, *10*(12), 2626. https://doi.org/10.3390/plants10122626

Desai, N., Gaikwad, D. K., & Chavan, P. D. (2010). Proximate composition and some physicochemical properties of *Morinda* pulp. *International Journal of Applied Biology and Pharmaceutical Technology*, *1*(2), 679–682.

Deshmukh, B. S., & Waghmode, A. (2011). Role of wild edible fruits as a food resource: Traditional knowledge. *International Journal of Pharmacy and Sciences*, *2*, 91.

Dinesh, B., Yadav, R., Deepak Reddy, A., Sai Padma, A., & Sukumaran, M. K. (2019). Determination of ascorbic acid content in some Indian spices. *International Journal of Current Microbiology and Applied Sciences*, *4*(8), 864–868.

Doğan, S., Turan, Y., Kara, H., & Arslan, O. (2005). Characterization and purification of polyphenol oxidase from artichoke (*Cynara scolymus* L.). *Journal of Agricultural and Food Chemistry, 53*(3), 776–785. https://doi.org/10.1021/jf049053g

Elleuch, M., Bedigian, D., Roiseux, O., Besbes, S., Becker, C., & Attia, H. (2011). Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. *Food Chemistry*, *124*(2), 411–421.

Gold, C. M. (2009). The nine essential amino acids. *CMG Archives*. http://campbelmgold.com

Hassan, L. G., & Umar, K. J. (2006). Nutritional value of Balsam apple leaves. *Pakistan Journal of Nutrition*, *5*(6), 522–529.

Hazali, N. B., Ali, M. A., Ibrahim, B. M., & Masri, M. (2015). Determination of phytochemicals and vitamin content of underutilized *Baccaurea angulata* fruit. *Journal of Pharmacognosy and Photochemistry*, *4*(4), 192–196.

Hurrell, R. (2004). Phytic acid degradation as a means of improving iron absorption. *International Journal for Vitamin and Nutrition Research*, *74*(6), 445–452.

Ibrahim, D., Hazali, N., Jauhari, N., Omar, M. N., Yahya, M. N. A., Ahmed, I. A., Mikail, M. A., & Ibrahim, M. (2013). Physico-chemical and antioxidant characteristics of *Baccaurea angulata* fruit juice extract. *African Journal of Biotechnology*, *12*(34), 5333–5338.

Ioniță-Mîndrican, C. B., Ziani, K., Mititelu, M., Oprea, E., Neacşu, S. M., Moroșan, E., Dumitrescu, D. E., Roșca, A. C., Drăgănescu, D., & Negrei, C. (2022). Therapeutic Benefits and Dietary Restrictions of Fiber Intake: A State-of-the-Art Review. *Nutrients*, *14*(13), 2641. https://doi.org/10.3390/nu14132641

Irakli, M., Lazaridou, A., & Biliaderis, C. G. (2020). Comparative Evaluation of the Nutritional, Antinutritional, Functional, and Bioactivity Attributes of Rice Bran Stabilized by Different Heat Treatments. *Foods (Basel, Switzerland)*, *10*(1), 57. https://doi.org/10.3390/foods10010057

Islary, A., Sarmah, J., & Basumatary, S. (2016). Proximate composition, mineral content, phytochemical analysis, and in vitro antioxidant activities of a wild fruit (*Grewia sapida* Rox. Ex DC.) found in Assam of North-East India. *Journal of Investigation Biochemistry*, *5*(1), 21–31.

John, S., Gunathilake, S., Aluthge, S., et al. (2025). Unlocking the potential of chia microgreen: Physicochemical properties, nutritional profile, and its application in noodle production. Food and Bioprocess Technology. https://doi.org/10.1007/s11947-025-03792-y.

Joseph, J. (2014). Phytochemistry and pharmacology of the genus Macaranga: A review. Journal of Medicinal Plants Research. 8. 489-503. 10.5897/JMPR2014.5396.

Justesen, U., & Knuthsen, P. (2011). Composition of flavonoids in fresh herbs. *Food Chemistry*, *73*(2), 245–250.

Krivorotova, T., & Sereikaite, J. (2014). Determination of fructan exohydrolase activity in the crude extracts of plants. *Electronic Journal of Biotechnology*, *17*(6), 329–333. https://doi.org/10.1016/j.ejbt.2014.09.005

Lako, J., Trenerry, V. C., Waniquist, M., Wattanapenpaiboon, N., Sotheswaran, S., & Premier, R. (2007). Phytochemical flavonoids, carotenoids, and antioxidant properties of a wide selection of Fijian fruits, vegetables, and other readily available foods. *Food Chemistry*, *101*, 1727–1741.

Le Veille, G. A., & Sauberlich, H. E. (1966). Mechanism of the cholesterol depressing effect of pectin in the cholesterol-fed rat. *Journal of Nutrition*, *88*, 209–214.

Liu, Y., Deng, J., Zhao, T., Yang, X., Zhang, J., & Yang, H. (2024). Bioavailability and mechanisms of dietary polyphenols affected by non-thermal processing technology in fruits and vegetables. Current Research in Food Science, 8, 100715. https://doi.org/10.1016/j.crfs.2024.100715.

Mahapatra, A. K., Mishra, S., Basak, U. C., & Panda, P. C. (2012). Nutrient analysis of some selected wild edible fruits of deciduous forests of India: An explorative study towards non-conventional bio-nutrition. *Advance Journal of Food Science and Technology*, *4*(1), 15–21.

Mann, S., Satpathy, G., & Gupta, R. K. (2016). Evaluation of nutritional and phytochemical profiling of *Baccaurea ramiflora* Lour. syn. *Baccaurea sapida* (Roxb.) Mull. Arg. fruits. *Indian Journal of Traditional Knowledge*, *15*(1), 135–142.

Mattila, P. H., Pihlava, J.-M., Hellström, J., Nurmi, M., Eurola, M., Mäkinen, S., Jalava, T., & Pihlanto, A. (2018). Contents of phytochemicals and antinutritional factors in commercial protein-rich plant products. *Food Quality and Safety*, *2*(4), 213–219. https://doi.org/10.1093/fqsafe/fyy021

Molino, S., Francino, M. P., & Rufián Henares, J. Á. (2023). Why is it important to understand the nature and chemistry of tannins to exploit their potential as nutraceuticals? Food Research International, 173(Part 2), 113329. https://doi.org/10.1016/j.foodres.2023.113329

Murugkar, D. A., & Subbulakshmi, G. (2005). Nutritive values of wild edible fruits, berries, nuts, roots and spices consumed by the Khasi tribes of India. *Ecology of Food and Nutrition*, *44*(3), 207–223.

Nandi, M. K., Garabadu, D., Singh, T. D., & Singh, V. P. (2016). Physicochemical and phytochemical standardization of fruit of *Sesbania grandiflora*. *Der Pharmacia Lettre*, *8*, 297–304.

Nayak, J., & Basak, U. C. (2015). Analysis of some nutritional properties in eight wild edible fruits of Odisha, India. *International Journal of Current Science*, *14*, 55–62.

Ngurthankhumi, R., Hazarika, T. K., Zothansiama, & Lalruatsangi, E. (2024). Nutritional composition and anti-nutritional properties of wild edible fruits of Northeast India. Journal of Agriculture and Food Research, 16, 101221. https://doi.org/10.1016/j.jafr.2024.101221.

Padayatty, S. J., Katz, A., Wang, Y., Eck, P., Kwon, O., Lee, J. H., Chen, S., Corpe, C., Dutta, A., Dutta, S. K., & Levine, M. (2003). Vitamin C as an antioxidant: Evaluation of its role in disease prevention. *Journal of the American College of Nutrition*, *22*(1), 18–35.

Pedroso, J. A., Zampieri, T. T., & Donato, J. Jr. (2015). Reviewing the effects of L-leucine supplementation in the regulation of food intake, energy balance, and glucose homeostasis. *Nutrients*, *7*(5), 3914–3937. https://doi.org/10.3390/nu7053914.

Potter, J. D. (2005). Vegetables, fruit, and cancer. *Lancet*, *366*, 527–530.

Rai, A. K., Sharma, R. M., & Tamang, J. P. (2005). Food value of common wild plants of Sikkim. *Journal of Hill Research*, *18*(2), 99–103.

Rajalakshmi, P., Kumar, V., Subhashini, G., Vadivel, V., & Pugalenthi, M. (2017). Underutilized fruits derived nutraceuticals: A rejuvenator. *Indian Journal of Scientific Research*, *13*(1), 46–53.

Rychter, A. M., Hryhorowicz, S., Słomski, R., Dobrowolska, A., & Krela-Kaźmierczak, I. (2022). Antioxidant effects of vitamin E and risk of cardiovascular disease in women with obesity – A narrative review. *Clinical Nutrition*, *41*(7), 1557–1565. https://doi.org/10.1016/j.clnu.2022.04.032

Sabir, S. M., & Riaz, K. (2005). Morphological, biochemical and elemental analysis of *Elaeagnus umbellata*, a multipurpose wild shrub from Pakistan. *Journal of Applied Horticulture*, *7*(2), 113–116.

Saha, D., Sundriyal, M., & Sundriyal, R. C. (2014). Diversity of food composition and nutritive analysis of edible wild plants in a multi-ethnic tribal land, North East India; and important facet for food supply. *Indian Journal of Traditional Knowledge*, *13*(4), 698–705.

Sejbuk, M., Mirończuk-Chodakowska, I., Karav, S., & Witkowska, A. M. (2024). Dietary polyphenols, food processing, and gut microbiome: Recent findings on bioavailability, bioactivity, and gut microbiome interplay. Antioxidants (Basel, Switzerland), 13(10), 1220. https://doi.org/10.3390/antiox13101220.

Singh, D. R., Singh, S., & Banu, V. S. (2014). Phytochemical composition, antioxidant activity and sensory evaluation of potential underutilized fruit crops. *Indian Journal of Nutrition and Dietetics*, *51*(2), 57-62.

Song, P., Adeloye, D., Li, S., Zhao, D., Ye, X., Pan, Q., Qiu, Y., Zhang, R., Rudan, I., & Global Health Epidemiology Research Group (GHERG) (2023). The prevalence of vitamin A deficiency and its public health significance in children in low- and middle-income countries: A systematic review and modelling analysis. *Journal of global health*, *13*, 04084. https://doi.org/10.7189/jogh.13.04084

Sree Lakshmi K. P., Mohammad Mansoor, E. Tamil Jothi, & Syamjith P. (2025). Macaranga Species: Phytochemicals, Health Benefits, and Cosmetic Potential. *International Journal of Pharmaceutical Sciences*, **3**(3), 1614-1622. https://doi.org/10.5281/zenodo.15043719.

Stephen, O. A., & Chibuzo, C. N. (2017). Determination of vitamin A content from selected Nigerian fruits using spectrophotometric method. *Bangladesh Journal of Scientific and Industrial Research*, *52*(2), 153.

Sudhakaran, A., & Nair, G. A. (2016). Nutritional evaluation of fruits of *Gynochthodes umbellata* (L.) Razafim & B. Bremer—An underutilized edible fruit plant. *Pharmacognosy Journal*, *8*(1), 76.

Sundriyal, M., & Sundriyal, R. C. (2003). Underutilized edible plants of the Sikkim Himalaya: Need for domestication. *Current Science*, *85*, 731–736.

Thanh, V. T. T., Mai, H. D. T., Pham, V. C., & Litaudon, M. (2012). Acetylcholinesterase inhibitors from leaves of *Macaranga kurzii*. *J. Nat. Prod.*, *75*, 2012–2015.

Waddell, I. S., & Orfila, C. (2022). Dietary fiber in the prevention of obesity and obesity-related chronic diseases: From epidemiological evidence to potential molecular mechanisms. *Critical Reviews in Food Science and Nutrition*, *63*(27), 8752–8767. https://doi.org/10.1080/10408398.2022.2061909

Willett, W. C. (2002). Balancing lifestyle and genomics research for disease prevention. *Science*, *296*(5568), 695–698.

Yiblet, Y. (2024). Nutritional composition and antinutritional factors of five wild edible fruits grown in the Mekdela District, South of Wollo, Ethiopia. The Scientific World Journal, 2024, 9980936. https://doi.org/10.1155/2024/9980936.

Zahidin, N. S., Saidin, S., Zulkifli, R. M., Muhamad, I. I., Ya'akob, H., & Nur, H. (2017). A review of *Acalypha indica* L. (Euphorbiaceae) as a traditional medicinal plant and its therapeutic potential. *J. Ethnopharmacol.*, *207*, 146–173.

Zakaria, I., Ahmat, N., Jaafar, F. M., & Widyawaruyanti, A. (2012). Flavonoids with antiplasmodial and cytotoxic activities of *Macaranga triloba*. *Fitoterapia*, *83*, 968–972.

Zhong, Q., Xiao, X., Qiu, Y., Xu, Z., Chen, C., Chong, B., Zhao, X., Hai, S., Li, S., An, Z., & Dai, L. (2023). Protein posttranslational modifications in health and diseases: Functions, regulatory mechanisms, and therapeutic implications. *MedComm.*, *4*(3), e261. https://doi.org/10.1002/mco2.261

Zixi, W., Bainian, S., Jin, P., Deng, P., Chen, J., & Sun, F. (2016). A new species of *Macaranga* from the middle Miocene of Fujian, China and its significance. *Hist Biol.*, *29*, 1–2.