Journal of Bio-Molecule Research and Engineering
Vol. XX | No. X |XXX - XXX| XXXX - XXXX | XXXX
e-ISSN: 2962-343X
http://www.e-journal.unair.ac.id/biome

Assessment of the Phytochemicals and Antioxidant Activity of *Baccaurea bracteata* Müll.Arg. and *Macaranga lowii* King ex Hook.f. from East Kalimantan

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ARTICLE INFO

Article history
Received 12th Sep 2023
Accepted 19th Nov 2023

Keywords:
antioxidant
DPPH
Baccaurea bracteata
Macaranga lowii
total phenolic content

ABSTRACT

This study investigated the total phenolic content and antioxidant activity of *Baccaurea bracteata* Müll.Arg. and *Macaranga lowii* King ex Hook.f. from East Kalimantan. The leaves of these plant extracts were evaluated for their total phenolic content (TPC) and antioxidant activity, utilizing the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay. The findings indicated that *Baccaurea bracteata* Müll.Arg. demonstrated superior antioxidant activity with a percent inhibition (PI) value of 68.31 ± 0.11%. This research highlights *Baccaurea bracteata* Müll.Arg. as a promising source of natural antioxidants, characterized by high total phenolic content of 14.76 ± 1.98 mgGAE/g.

1. Introduction

Non-timber forest products (NTFPs) encompass a variety of goods derived from forest ecosystems, including medicinal plants, honey, mushrooms, resins, fruits, nuts, vegetables, barks, and natural fibers. These products play a crucial role in sustaining the livelihoods of local communities residing in proximity to forested areas. As previously highlighted, medicinal plants represent a significant category of NTFPs that have been employed in traditional medicine for the treatment of various ailments since antiquity [1, 2]. The utilization of plants for medicinal purposes can be traced back to the earliest human civilizations, reflecting humanity's longstanding reliance on flora as a primary source of sustenance [3]. Medicinal plants are recognized for their rich content of diverse bioactive secondary metabolites, such as phenolics, flavonoids, alkaloids, terpenes, and tannins, which exhibit therapeutic properties, including anti-diabetic, antioxidant, anti-inflammatory, wound-healing, and antibacterial effects [4, 5]. The tropical rainforests of East Kalimantan are particularly abundant in medicinal plant species, offering a wide array of flora that may serve as potential therapeutic agents for various health conditions [6]. The indigenous Dayak ethnic group in East Kalimantan

predominantly relies on local medicinal plants, utilizing herbal remedies either independently or in conjunction with contemporary medical treatments to address numerous health issues. However, the identification of these medicinal plants is often limited to their local nomenclature or specific characteristics, and the scientific investigation of traditional medicinal plant species has yet to be comprehensively undertaken. Therefore, it is imperative to prioritize further research on the phytochemical constituents and biological activities of these traditional medicinal plant species.

Antioxidants play a crucial role in neutralizing free radicals and preventing cellular damage. Among the most prevalent synthetic antioxidants are butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT), both of which have been associated with a range of adverse effects, including hepatotoxicity and potential carcinogenicity [7]. Consequently, there is a growing demand for safer and more environmentally friendly alternatives, leading to an increasing preference for natural antioxidants [8]. Although medicinal plants of East Kalimantan have long been used in traditional medicine to treat different illnesses including diabetes, there is a lack of scientific information on their antidiabetic and antioxidant activities. Information about traditional uses of ethnomedicinal plants in East Kalimantan is passed down from generation to generation. Therefore, in this study, we investigated *Baccaurea bracteata* Müll.Arg. and *Macaranga lowii* King ex Hook.f as ethnomedicinal plants to evaluate their potency as antidiabetic agents and free radical scavengers as well as to provide a scientific background to their traditional uses as ethnomedicinal plants.

2. Materials and methods

2.1.Plant materials

A selection of two species, namely *Baccaurea bracteata* Müll.Arg. and *Macaranga lowii* King ex Hook.f., was derived from chemotaxonomic research and ethnopharmacological data concerning plants that have been extensively utilized for therapeutic purposes and demonstrate notable pharmacological attributes [9, 10]. The aforementioned medicinal plant species were collected in October 2020 from the Balikpapan Botanical Garden.

2.2. Chemical reagents and instrument

DPPH (*1,1-diphenyl-2-picrylhydrazyl*) were procured from Tokyo Chemical Industry Co. Ltd, Folin ciocalteau, sodium hydrogen carbonate, while all remaining chemicals and solvents utilized in the study were of premium commercial quality ascorbic acid were purchased from Sigma Chemical Co (St. Louis, MO, USA). Absorbance measurements were taken using a 96-well Thermo Scientific Multiskan SkyHigh RE 6.1.1 microplate reader.

2.3. Extraction of medicinal plants

The plant leaves were washed with distilled water and subsequently air-dried in a well-ventilated environment at ambient temperature. The dried material was then finely ground utilizing a grinder and subjected to extraction procedures with 96% ethanol (3 x 400 mL). The resulting mixtures were macerated at room temperature and filtered through filter paper. The filtrate was concentrated under vacuum using a rotary evaporator (Rotavapor R100, BUCHI) to obtain a dry crude extract. This extract was subsequently transferred to amber containers and stored at 4°C for future bioassay evaluations.

2.4. Total Phenolic Content (TPC)

The total phenolic content (TPC) of the selected plant extracts was assessed following the methodology outlined by Abeysinghe et al. (2021), employing the Folin-Ciocalteu reagent with minor modifications. A volume of 0.5 mL of appropriately diluted plant extract was combined with the Folin-Ciocalteu reagent for the analysis. Various concentrations of plant extracts from each part were prepared through appropriate dilutions based on their total phenolic contents. The absorbance of each solution was recorded at a wavelength of 750 nm. A calibration curve was established using gallic acid as the standard reference compound, with concentrations ranging from 20 μg/mL to 100 μg/mL. The quantification of total phenolic content was expressed in milligrams of gallic acid equivalents per gram of dried sample (mg GAE/g).

2.5. DPPH radical scavenging activity

The DPPH free radical was employed to evaluate the antioxidant activity of extracts derived from selected medicinal plants, utilizing a methodology adapted from Khongkarat et al. (2020) with minor modifications. Specifically, 20 μL of various concentrations of the chosen plant extracts were mixed with a 0.1 mM DPPH methanol solution. The reaction mixture was incubated in the dark, and after a duration of 30 minutes, the absorbance was measured at 517 nm using a 96-well Thermo Scientific Multiskan SkyHigh RE 6.1.1 microplate reader. The antioxidant activity of the samples was expressed as percentage inhibition (PI), calculated using the formula: % scavenging activity = (Abs control – Abs sample)/Abs control x 100. The experiment was conducted in triplicate, and the results were reported as the mean ± standard deviation of the scavenging activity.

2.6 Data analysis

All data are presented as the average of three measurements. All measurements were taken in triplicate. Quantitative data obtained were presented in graphs and analyzed descriptively.

3. Results and discussion

This study was conducted to determine the antioxidant potential of namely *B. bracteata* Müll.Arg. and *M. lowii* King ex Hook.f., extracts from East Kalimantan using DPPH and total phenolic contents (TPC) methods measured using a Thermo Scientific Multiskan SkyHigh RE 6.1.1 microplate reader. The results are presented in Table 1. Ethanol 96% extract of *B. bracteata* Müll.Arg. at 100 μg/mL in DPPH free radical scavenging activity has the highest antioxidant activity with a percent antioxidant activity value of 68.31 ± 0.11%. The percent value of antioxidant activity shows the ability of an antioxidant compound in the sample to capture DPPH free radicals into stable molecules with marked changes in DPPH color from purple to yellow [11]. The greater the percent value of antioxidant activity, the higher the ability to inhibit free radicals. Some research on the antioxidant activity of another species of *Baccaurea* has been reported by Whitten and Whitten (1987) that the methanol extract of *Baccaurea racemosa* has a weak percentage of antioxidant activity against DPPH free radical. Pasaribu et al. (2020) also reported that the methanol extract of *Baccaurea tetrandra* has a strong IC_{50} of antioxidant activity.

The total phenolic contet (TPC) is well-known for its superior antioxidant properties, which are attributed to its distinctive redox characteristics. This allows phenolic compounds to act as

effective reducing agents, hydrogen donors, and singlet oxygen quenchers [14]. The results of the total phenolic test showed that *B. bracteata* Müll.Arg. has the highest than *M. lowii* King ex Hook.f. of 14.76 ± 1.98 mgGAE/g. Additionally, a study on the fruit of *B. bracteata* in Sumatera regions revealed a higher total phenolic content in the leaves a 89.45 mg/g compared to our current results [13]. The results of this study are different allegedly because according to Li et al. (2020) differences in the place of growth of a plant affect the precursors of secondary metabolite biosynthesis which may be effective on its bioactivity, and according to Bibi et al. (2014) the use of solvents during extraction affects the total content of bioactive compounds due to differences in the polarity of the solvent.

Table 1. Antioxidant activity and total phenolic contents (TPC) of *Baccaurea bracteata* Müll.Arg. and *Macaranga lowii* King ex Hook.f.

Samples	Percent inhibition (%)	Total Phenolic Contents (TPC)
	DPPH	
Baccaurea bracteata Müll.Arg.	68.31 ± 0.11	14.76 ± 1.98
Macaranga lowii King ex Hook.f.,	14.26 ± 0.83	4.93 ± 1.71
Ascorbic Acid (Vit C)	96.421 ± 0.738	

Values are presented as mean ± SD
DPPH free radical scavenging were expressed as percentage of scavenging capacity.

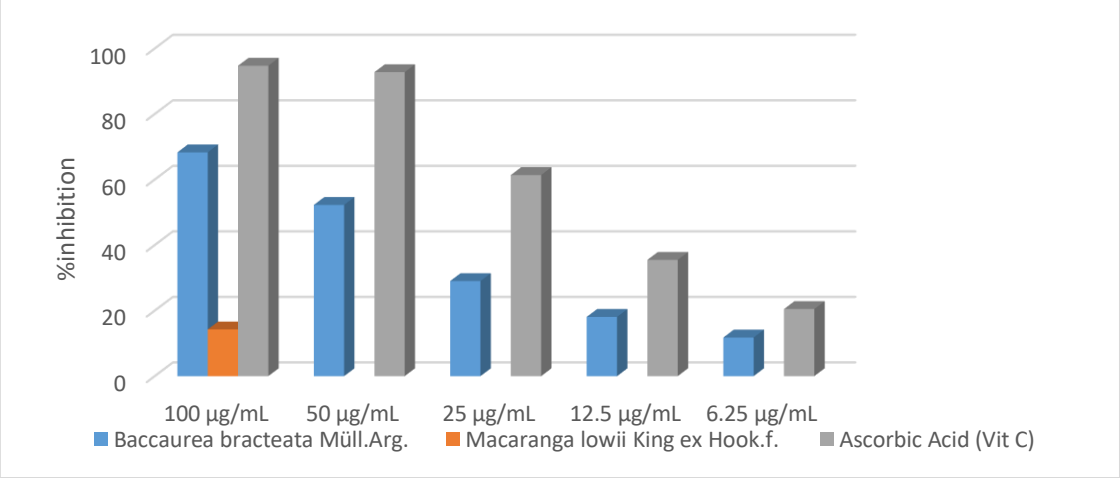

Figure 1. Antioxidant activity of *Baccaurea bracteata* Müll.Arg. and *Macaranga lowii* King ex Hook.f.

Figure 1. shows that the percentage of DPPH free radical inhibition of *B. bracteata Müll.Arg. and M. lowii King ex Hook.f.*, increased with increasing concentration. This percent value of antioxidant activity is almost similar to the percent value of antioxidant activity of the positive control ascorbic acid. *B. bracteata* extract with ethanol solvent has higher antioxidant potential compared to *M. lowii King ex Hook.f.* Antioxidant agents have characteristics as proton donors and electron donors, so flavonoids, alkaloids and phenolic groups can be an alternative antioxidant agent from plants. Sofiyanti et al. (2022) provide information about the content of *Baccaurea* based on the results of phytochemistry, namely phenolics, flavonoids, alkaloids, terpenoid, steroid, saponin and tannins.

4. Conclusions

Extracts of *B. bracteata* Müll.Arg. and *M. lowii* King ex Hook.f. were obtained through a maceration process utilizing ethanol as the solvent. The antioxidant activity of these extracts was assessed using the DPPH method, while phytochemical analysis was conducted to determine total phenolic content (TPC). The findings from the antioxidant evaluation indicated that the extract of *B. bracteata* Müll.Arg. exhibited superior inhibitory capacity as measured by the DPPH assay value of 68.31 ± 0.11%, and characterized by high total phenolic content of 14.76 ± 1.98 mgGAE/g. Consequently, it is recommended that further investigations be conducted on B. bracteata Müll.Arg. extract, including isolation procedures and additional bioactivity assessments.

Acknowledgements

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References

[1] P. Y. Mbopi *et al.*, "Chemical constituents, total phenolic content, antioxidant activity and bactericidal effect of Dicliptera verticillate (Acanthaceae)," *South African Journal of Botany*, vol. 142, pp. 216-221, 2021.

[2] P. Mipun, N. A. Bhat, D. Borah, and Y. Kumar, "Non-timber forest products and their contribution to healthcare and livelihood security among the Karbi tribe in Northeast India," *Ecological Processes*, vol. 8, pp. 1-21, 2019.

[3] B. Paudel *et al.*, "Estimation of antioxidant, antimicrobial activity and brine shrimp toxicity of plants collected from Oymyakon region of the Republic of Sakha (Yakutia), Russia," *Biological research*, vol. 47, pp. 1-6, 2014.

[4] T. Bibi *et al.*, "Ethnobotany of medicinal plants in district Mastung of Balochistan province-Pakistan," *Journal of ethnopharmacology*, vol. 157, pp. 79-89, 2014.

[5] J. O. Odukoya, J. O. Odukoya, E. M. Mmutlane, and D. T. Ndinteh, "Ethnopharmacological study of medicinal plants used for the treatment of cardiovascular diseases and their associated risk factors in sub-Saharan Africa," *Plants*, vol. 11, no. 10, p. 1387, 2022.

[6] G. Pasaribu, T. Waluyo, and I. Winarni, "Phytochemical content, toxicity and antioxidant activities of native medicinal plants from North Sumatra," in *IOP Conference Series: Earth and Environmental Science*, 2020, vol. 591, no. 1: IOP Publishing, p. 012026.

[7] S. Meenakshi, D. M. Gnanambigai, S. T. Mozhi, M. Arumugam, and T. Balasubramanian, "Total flavanoid and in vitro antioxidant activity of two seaweeds of Rameshwaram coast," *Global Journal of Pharmacology*, vol. 3, no. 2, pp. 59-62, 2009.

[8] S. Adeel, S. Ali, I. A. Bhatti, and F. Zsila, "Dyeing of cotton fabric using pomegranate (Punica granatum) aqueous extract," *Asian Journal of Chemistry*, vol. 21, no. 5, p. 3493, 2009.

[9] I. A. Ahmed *et al.*, "Antioxidant activity and phenolic profile of various morphological parts of underutilised Baccaurea angulata fruit," *Food chemistry*, vol. 172, pp. 778-787, 2015.

[10] E. Rosamah *et al.*, "The potential of Macaranga plants as skincare cosmetic ingredients: A review," *Journal of Applied Pharmaceutical Science*, vol. 13, no. 7, pp. 001-012, 2023.

[11] D. Abeysinghe, K. Kumara, K. Kaushalya, U. Chandrika, and D. Alwis, "Phytochemical screening, total polyphenol, flavonoid content, in vitro antioxidant and antibacterial activities of Sri Lankan varieties of Murraya koenigii and Micromelum minutum leaves," *Heliyon*, vol. 7, no. 7, 2021.

[12] P. Khongkarat, R. Ramadhan, P. Phuwapraisirisan, and C. Chanchao, "Safflospermidines from the bee pollen of Helianthus annuus L. exhibit a higher in vitro antityrosinase activity than kojic acid," *Heliyon,* vol. 6, no. 3, 2020.
[13] J. E. Whitten and A. J. Whitten, "Analysis of bark eating in a tropical squirrel," *Biotropica,* pp. 107-115, 1987.
[14] N. Kumar and N. Goel, "Phenolic acids: Natural versatile molecules with promising therapeutic applications," *Biotechnology reports,* vol. 24, p. e00370, 2019.
[15] Y. Li, D. Kong, Y. Fu, M. R. Sussman, and H. Wu, "The effect of developmental and environmental factors on secondary metabolites in medicinal plants," *Plant physiology and biochemistry,* vol. 148, pp. 80-89, 2020.
[16] N. Sofiyanti, F. FITMAWATI, M. N. Isda, A. R. A. Agesti, M. Sari, and S. Pranata, "Baccaurea Lour.*(Phyllanthaceae Martinov-Malpighiales),* underutilized plant from Riau, Indonesia and its phytochemical study," *Biodiversitas Journal of Biological Diversity,* vol. 23, no. 2, 2022.