Proceedings Academic Universitas Jambi
Volume 2, Issue 2, Juli, 2026

Phytochemical Screening and Antioxidant Activities of Ethanolic Extracts of *Metaxya parkeri* (Hook. & Grev.) J.Sm.

Uni Baroroh Husnudin[1], Dina Erliana[2], Munifilia Ekasari[3], Andini Vermita Bestari[4], and Anggari Linda Destiana[5]
[1,2,3,4,5] Universitas Jambi, Jambi, Indonesia
*Corresponding Author: uni.baroroh.h@unja.ac.id

Abstract

Background: *Metaxya parkeri* (Hook. & Grev.) J.Sm. is a fern species whose pharmacological potential has not been extensively explored. **Objective:** This study aimed to screen phytochemical compounds and evaluate the antioxidant activity of ethanolic extracts from the petiole and pinnae of *M. parkeri*. **Methods:** Extraction was performed using maceration with 96% ethanol. Qualitative phytochemical screening was conducted to detect alkaloids, flavonoids, saponins, tannins, and terpenoids. Antioxidant activity was determined using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method and expressed as the inhibitory concentration 50 (IC50). **Results:** Both petiole and pinnae extracts tested positive for alkaloids, tannins, saponins, and flavonoids. The ethanolic extracts exhibited weak antioxidant activity, with IC50 values of 160.54 ± 4.63 ppm for the petiole and 117.81 ± 0.61 ppm for the pinnae, whereas ascorbic acid as the positive control demonstrated strong activity (44.75 ± 0.67 ppm). **Conclusion:** *M. parkeri* contains bioactive compounds; however, their concentration in the crude ethanolic extract may be insufficient to produce strong antioxidant activity, suggesting the need for further extraction or purification methods.

Keywords: *Metaxya parkeri*; antioxidant; DPPH; phytochemicals; ethanolic extract

Cite This Article

Uni Baroroh Husnudin, Dina Erliana, Munifilia Ekasari, Andini Vermita Bestari, Anggari Linda Destiana (2026). Phytochemical Screening and Antioxidant Activities of Ethanolic Extracts of *Metaxya parkeri* (Hook. & Grev.) J.Sm. Proceedings Academic Universitas Jambi, 2(2): e55583. DOI: 10.22437/proca.v2i2.55583

Editor

Kevin Waldo, M.Pd

Article info

Received: Mei 15, 2026 · Revised: Juli 06, 2026 · Accepted: Juli 11, 2026

© 2026 The Author(s). Published with license by LPPM Universitas Jambi. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International (CC BY 4.0 International). This license enables reusers to distribute, remix, adapt, and build upon the material in any medium or format, so long as attribution is given to the creator.

INTRODUCTION

Free radicals are chemical compounds recognized as a major contributing factor to various diseases [1]. Free radicals are highly reactive and unstable species characterized by the presence of unpaired electrons in their outer orbitals. To achieve stability, free radicals attack vital biological molecules such as proteins, lipids, and DNA, leading to structural and functional impairment of these macromolecules [2,3]. Free radicals are primarily categorized into two groups: reactive oxygen species (ROS) and reactive nitrogen species (RNS). The formation of free radicals occurs through specific chemical reactions, resulting in an imbalance between antioxidants and pro-oxidants within the body [2]. Maintaining a homeostatic balance between free radicals and antioxidants is crucial; when the production of free radicals exceeds the body's antioxidant capacity, it can trigger tissue damage and the onset of diseases. The deleterious effects of free radicals include premature aging, the progression of various degenerative diseases, such as cancer, cardiovascular diseases, and neurodegenerative disorders, chronic inflammation, and immune system dysfunction [1,2].

The critical role of antioxidants in preventing cellular damage induced by free radicals has driven research into the utilization and development of natural antioxidants within the pharmaceutical and health sectors [4]. Antioxidant sources can be derived from various plants, with ferns (Pteridophyta) representing a significant potential source. Previous studies indicate that various fern species contain secondary metabolites such as terpenoids, tannins, alkaloids, flavonoids, and phenolics, which exhibit potential antioxidant properties [5-8]. However, research regarding the bioactivity of ferns in the tropical forests of Indonesia, particularly in the Jambi region, remains limited.

One species of particular interest is *Metaxya parkeri* (Hook. & Grev.) J.Sm., which is found in the Depati Karo Jayo Tuo Customary Forest, Jambi. This plant belongs to the family Metaxyaceae and the order Cyatheales. Morphologically, *M. parkeri* possesses unique frond characteristics and distinct sori placement. To date, information regarding the phytochemical profile and bioactivity of *M. parkeri* is scarce compared with its close relatives within the Cyatheales order. Most botanical studies on this genus have focused primarily on morphological and taxonomic aspects [9,10]; consequently, its pharmacological potential, particularly as a source of natural antioxidants, has not been extensively explored. Therefore, this study aimed to screen phytochemical compounds and evaluate the antioxidant activity of ethanolic extracts from the petiole and pinnae of *M. parkeri*.

METHODS

Research time and location

This research was conducted from July to November 2025. Samples of *M. parkeri* were collected from the Depati Karo Jayo Tuo Customary Forest, Merangin Regency, Jambi. Phytochemical screening was performed at the Final Project Laboratory, Faculty of Science and Technology, Universitas Jambi. Antioxidant testing was conducted at the Analysis Laboratory, Faculty of Animal Science, Universitas Jambi.

Research procedure

The procedure for phytochemical and antioxidant testing began with dry sample extraction. Maceration was employed to extract the petiole and pinnae of *M. parkeri* using 96% ethanol (EtOH) as the solvent. The solvent was subsequently removed from the filtrate using a rotary evaporator to obtain a viscous crude extract.

Qualitative phytochemical screening was conducted to detect the presence of secondary metabolites such as alkaloids, saponins, tannins, flavonoids, triterpenoids, and steroids, which are known to possess antioxidant properties. The screening used various chemical reagents, including Mayer's reagent, Dragendorff's reagent, FeCl3, acetic anhydride (CH3COOH), magnesium powder, H2SO4, and concentrated HCl.

The antioxidant activity assay was performed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method, modified from Salazar-Aranda et al. [11], using a DPPH concentration of 20 ppm. The extract was tested at concentrations of 20, 40, 60, 80, and 100 ppm. These concentration ranges were determined based on preliminary tests to ensure optimal readings for each sample type. Ascorbic acid was used as the positive control at the same concentrations as the sample extracts.

The reaction mixture was prepared by combining the DPPH solution and the sample extract in a ratio of 3.8 mL DPPH to 0.2 mL extract. The positive control was prepared using the same ratio. The mixture was incubated for 30 minutes, after which the absorbance was measured using a UV-Vis spectrophotometer at a wavelength of 517 nm in duplicate, using 96% ethanol as the blank. The percentage of DPPH inhibition was calculated using the following formula: % inhibition = [(A - B) / A] × 100, where A is the absorbance of the negative control (DPPH + ethanol), and B is the absorbance of the sample mixture (DPPH + ethanol + sample).

A graph plotting the relationship between the concentration of the test solution and the percentage of inhibition was generated to calculate the IC50 value based on the obtained linear regression equation. IC50 is defined as the concentration of the extract required to inhibit 50% of DPPH activity. Antioxidant activity is classified into five groups based on Phongpaichit et al. [12]: very strong (<10 ppm), strong (10-50 ppm), moderate (50-100 ppm), weak (100-250 ppm), and very weak (>250 ppm).

Data analysis

Data analysis was conducted both qualitatively and quantitatively. The qualitative analysis involved describing the phytochemical detection results of *M. parkeri* based on the color changes observed before and after the addition of specific reagents. Antioxidant assay data were analyzed quantitatively by calculating the IC50 values of the samples.

RESULTS

Metaxya parkeri (Hook. & Grev.) J.Sm.

Metaxya parkeri is a fern belonging to the Metaxyaceae family. This plant is one of the ferns that can be found in tropical rainforest areas with the widest distribution among other species in the Metaxya genus [9]. The *M. parkeri* used in this study was sampled from the Depati Karo Jayo Tuo Customary Forest in Merangin Regency, Jambi, based on the exploration results of Nazila et al. [13] and was further identified. The results of identification using morphological characteristics based on references from Cardenas et al. [9] and Remedios et al. [10] showed similarities between the morphological characteristics of the samples and *M. parkeri*.

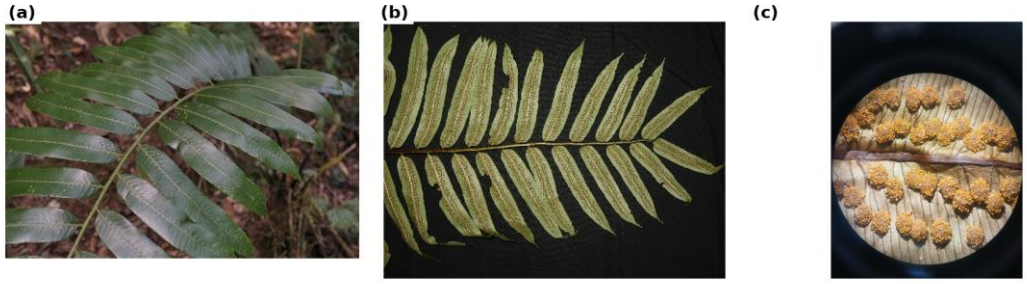

Figure 1. Morphology of M. parkeri. (a, b) Lamina; (c) sori.

This plant is commonly found in the Depati Karo Jayo Tuo Customary Forest at an altitude of 1,100 meters above sea level. *M. parkeri* has an upright stem that can reach a length of 1.2 meters. The petiole is longer than the lamina. There are 6-22 pinnae on each side. The pinnae are narrow-lanceolate to oblong-elliptic, 14.3-20.6 cm long and 2.5-3.8 cm wide. The texture of the pinnae is herbaceous or thin and soft, the edges of the pinnae are slightly serrated, the base of the pinnae is oblique, the tip is long-attenuate to caudate, serrate or dentate, sometimes falcate. The sori are located on the abaxial side, numbering 2-4 per leaf vein, and their arrangement varies from concentrated near the midvein to scattered across the abaxial surface of the pinnae (Figure 1).

Phytochemical screening

Phytochemical test results showed that all samples contained various types of bioactive compounds (Table 1), as indicated by color changes in the extract after the addition of various reagents (Figure 2).

Table 1. Results of phytochemical testing of ethanol extracts from ferns.

Ethanol extract	Chemical compound	Positive reaction	Result	Description
Petiole M. parkeri	Alkaloid (Dragendorff)	Sediment formed	Sediment formed	Positive
	Alkaloid (Mayer)	Sediment formed	Sediment formed	Positive
	Saponin	Foam formed	Foam formed	Positive
	Tannin	Blackish green color	Blackish green color	Positive
	Flavonoid	Red, orange, or yellow	Reddish orange	Positive
	Triterpenoid and steroid	A red ring formed	Brown	Negative
Pinnae M. parkeri	Alkaloid (Dragendorff)	Sediment formed	Sediment formed	Positive
	Alkaloid (Mayer)	Sediment formed	Sediment formed	Positive
	Saponin	Foam formed	Foam formed	Positive
	Tannin	Blackish green color	Blackish green color	Positive
	Flavonoid	Red, orange, or yellow	Reddish orange	Positive
	Triterpenoid and steroid	A red ring formed	Brown	Negative

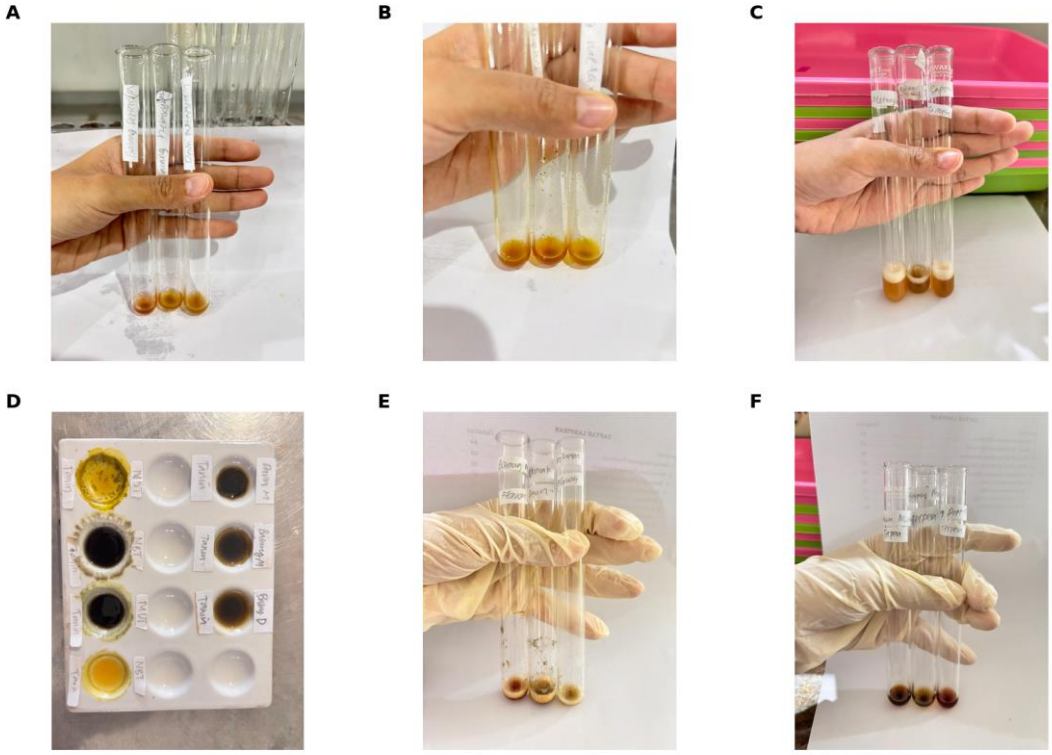

Figure 2. Qualitative phytochemical test results of samples using various reagents. (A) Dragendorff alkaloid reagent; (B) Mayer alkaloid reagent; (C) saponin; (D) tannin; (E) flavonoid; (F) triterpene and steroid.

Antioxidant activity

Antioxidants are chemical compounds that play a role in counteracting free radicals. Antioxidant compounds in plants are usually produced in the form of secondary metabolites, the types and levels of which vary between organs and plant species. Antioxidant activity can be measured using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) method. DPPH is a free radical compound that is mixed with sample extracts at various concentrations. A color change in the DPPH solution from purple to yellow indicates a reaction in which DPPH free radicals are captured by antioxidant compounds. Antioxidant activity was measured using spectrophotometry at a wavelength of 517 nm. The absorbance value was used to calculate the percentage of inhibition and IC50 value to determine the magnitude of antioxidant activity. The IC50 value is defined as the concentration of extract needed to inhibit 50% of free radical activity; the higher the IC50 value, the lower the antioxidant activity [23].

Based on the test results, the percentage of inhibition of the ethanol extracts of *M. parkeri* petioles and pinnae showed an increasing trend with increasing concentration, although the inhibition values remained below those of the positive control, ascorbic acid (Figure 3).

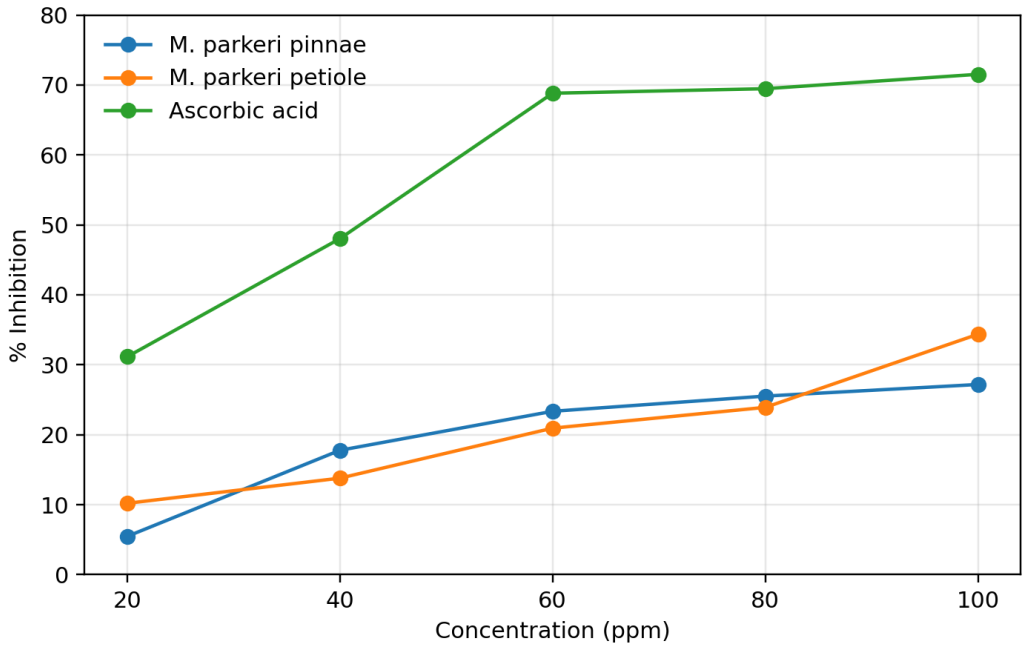

Figure 3. Percentage inhibition graph of M. parkeri ethanol extract and positive control.

The antioxidant activity of ethanol extracts from the petioles and pinnae of *M. parkeri* had IC50 values in the range of 100-250 ppm, which is classified as weak antioxidant activity when compared with the positive control, ascorbic acid, which showed strong antioxidant activity (Table 2).

Table 2. Antioxidant activity.

Sample	IC50	Category
M. parkeri petiole	160.54 ± 4.63 ppm	Weak
M. parkeri pinnae	117.81 ± 0.61 ppm	Weak
Ascorbic acid	44.75 ± 0.67 ppm	Strong

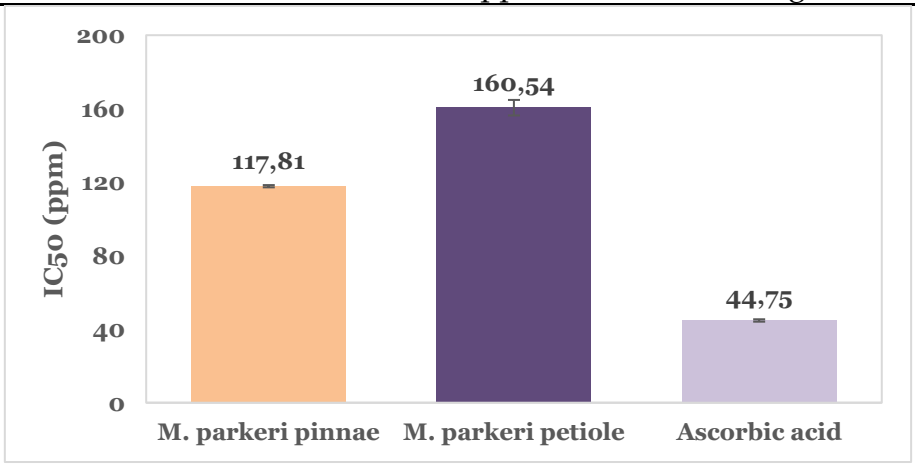

Figure 4. Comparison of IC50 values of M. parkeri ethanol extract and positive control.

DISCUSSION

Secondary metabolites are metabolites that are generally produced by plants. The function of secondary metabolites in plants is as defense compounds against stress caused by other

organisms, including pathogenic microbes, herbivores, viruses, and nematodes, and by the environment, as well as acting as pollinator attractants [14,15]. Secondary metabolites can be found in all plant organs, but their distribution is uneven. The types and levels of secondary metabolites in each organ vary depending on the function of the organ and the condition of the plant [14,16]. Secondary metabolites in plants are also beneficial to humans because they may function as antioxidants, anti-inflammatory agents, antibacterial compounds, and anticancer compounds [17].

The ethanol extracts of *M. parkeri* petioles and pinnae showed positive reactions for the presence of alkaloids, tannins, flavonoids, and saponins, but negative reactions for triterpenoids and steroids. This result may be related to the type of solvent used in the extraction. The solvent used was 96% ethanol, which is a polar solvent; therefore, the dissolved compounds were mainly compounds with polar groups, such as alkaloids [18], tannins and flavonoids [19], and saponins [20]. Terpenes and steroids cannot be optimally extracted in ethanol solvent because these compounds are relatively non-polar [21], so they were not detected in the petiole and pinnae extracts of *M. parkeri*. In comparison, a previous study on the rhizome organ of its close relative, *M. rostrata*, showed the presence of sterols, phenolic compounds, and saccharides in water extracts [22], indicating possible variations in metabolite distribution among plant organs.

In ethanol extracts of *M. parkeri* petioles and pinnae, secondary metabolites such as alkaloids, tannins, flavonoids, and saponins were found, indicating that the extracts contain compounds that may contribute to antioxidant activity. The antioxidant activity of *M. parkeri* extract is strongly suspected to be related to the content of phenolic compounds such as flavonoids and tannins detected in phytochemical tests. This is in accordance with Vetter [15], who stated that ferns and fern allies have considerable antioxidant potential, mainly through their phenolic compounds. Phenolic compounds are known to donate hydrogen atoms from their hydroxyl groups to stabilize DPPH free radicals [23].

The high antioxidant activity of ascorbic acid as the positive control is rational because ascorbic acid is a pure compound, whereas the ethanol extract of *M. parkeri* is a crude extract that still contains a mixture of various compounds other than antioxidants. Although the antioxidant activity in the petioles and pinnae of *M. parkeri* was classified as weak, these results show a profile comparable with the antioxidant activity in a close relative from the order Cyatheales, namely *Cyathea contaminans* (family Cyatheaceae), which shows very weak activity in young leaves and weak to strong activity in old leaves [24]. This indicates that antioxidant potential in this group may be influenced by tissue maturity or other environmental factors.

Pinnae extracts showed higher antioxidant activity than petiole extracts, as indicated by their lower IC50 value (Figure 4). This difference indicates that, in these samples, the distribution of phenolic compounds or compounds with antioxidant activity was not concentrated in the petiole but was more prominent in the pinnae tissue. The difference in antioxidant activity between the petiole and pinnae may also be due to differences in the distribution of secondary metabolites. For example, terpenes and their derivatives in *Pteridium aquilinum* are found in the highest concentrations in the rhizome, followed by the roots and fronds. In *Microsorum membranifolium* and *M. scolopendria*, these compounds may also differ among rhizome, root, and frond tissues [15]. In addition, the levels of antioxidant compounds such as phenolic compounds can differ in each plant organ. Free phenolic compounds can be stored in cell vacuoles and are found in woody tissue [25].

CONCLUSIONS

M. parkeri contains bioactive compounds. Phytochemical screening revealed that both petiole and pinnae extracts tested positive for alkaloids, tannins, saponins, and flavonoids. The ethanolic extracts exhibited weak antioxidant activity, with IC50 values of 160.54 ± 4.63 ppm for the petiole and 117.81 ± 0.61 ppm for the pinnae, whereas the positive control, ascorbic acid, demonstrated strong activity (44.75 ± 0.67 ppm). However, the concentration of antioxidant compounds in the crude ethanolic extract may be insufficient to produce strong antioxidant activity, suggesting the need for further extraction or purification methods in future research.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

FUNDING

This work was supported by the Beginner Lecturer Research (PDP) grant, Non-Tax State Revenue (PNBP), Faculty of Science and Technology, Universitas Jambi.

ACKNOWLEDGMENT

The authors thank the Faculty of Science and Technology, Universitas Jambi, for research support and laboratory facilities.

DECLARATION OF ARTIFICIAL INTELLIGENCE USE

AI-based language tools were used only to support language refinement, formatting, and reference style adjustment during manuscript preparation. The authors critically reviewed all AI-assisted outputs to ensure the integrity and reliability of the manuscript. The final decisions, scientific interpretations, and conclusions presented in this article remain solely the responsibility of the authors.

REFERENCES

1. Anggarani MA, Ilmiah M, Mahfudhah N. Literature review of antioxidant activity of several types of onions and its potensial as health supplements. Indonesian Journal of Chemical Science. 2023;12(1):103-111. doi:10.15294/IJCS.V12I1.57689.
2. Chandimali N, Bak SG, Park EH, Lim HJ, Won YS, Kim EK, Park SI, Lee SJ. Free radicals and their impact on health and antioxidant defenses: a review. Cell Death Discovery. 2025;11(1):1-17. doi:10.1038/s41420-024-02278-8.
3. Lobo V, Patil A, Phatak A, Chandra N. Free radicals, antioxidants and functional foods: impact on human health. Pharmacognosy Reviews. 2010;4(8):118-126. doi:10.4103/0973-7847.70902.
4. Zehiroglu C, Ozturk Sarikaya SB. The importance of antioxidants and place in today's scientific and technological studies. Journal of Food Science and Technology. 2019;56(11):4757-4774. doi:10.1007/s13197-019-03952-x.
5. Azka S, Azirda M. Diversity and bioprospecting of Pteridophyte in the Indigenous Talang Mamak Tribe, Riau, Indonesia. SABRAO Journal of Breeding and Genetics. 2024;56(5):1845-1857. doi:10.54910/sabrao2024.56.5.9.
6. Nurhasnawati H, Sundu R, Sapri, Supriningrum R, Kuspradini H, Arung ET. Antioxidant activity, total phenolic and flavonoid content of several indigenous species of ferns in East Kalimantan, Indonesia. Biodiversitas Journal of Biological Diversity. 2019;20(2):576-580. doi:10.13057/biodiv/d200238.
7. Yumkham SD, Elangbam M, Nongmaithem R, Naorem PD, Singh PK. Maiden hair ferns (Adiantum L., Pteridaceae-Vittarioideae) of North East India: diversity, phytochemistry and utilization. Genetic Resources and Crop Evolution. 2018;65(4):1269-1280. doi:10.1007/s10722-018-0612-y.

8. Chetia P, Dey D, Puzari M, Dutta Choudhury M. Bioactive compounds and biological activities of Dipteris wallichii. In: Murthy HN, editor. Bioactive Compounds in Bryophytes and Pteridophytes. Cham: Springer; 2022. p. 1-10. doi:10.1007/978-3-030-97415-2_15-1.

9. Cardenas GG, Tuomisto H, Lehtonen S. Newly discovered diversity in the tropical fern genus Metaxya based on morphology and molecular phylogenetic analyses. Kew Bulletin. 2016;71(1):1-27. doi:10.1007/s12225-016-9618-9.

10. Remedios TS, Silva ABB, Luciano JS, Pinangé DSB, Amorim BS. Novos registros e reconhecimento morfológico das espécies de Metaxya C. Presl (Metaxyaceae) na Amazônia brasileira. Hoehnea. 2022;49(6):1-13. doi:10.1590/2236-8906-63-2021.

11. Salazar-Aranda R, Pérez-López LA, López-Arroyo J, Alanís-Garza BA, Waksman de Torres N. Antimicrobial and antioxidant activities of plants from northeast of Mexico. Evidence-Based Complementary and Alternative Medicine. 2011;2011:536139. doi:10.1093/ecam/nep127.

12. Phongpaichit S, Nikom J, Rungjindamai N, Sakayaroj J, Hutadilok-Towatana N, Rukachaisirikul V, Kirtikara K. Biological activities of extracts from endophytic fungi isolated from Garcinia plants. FEMS Immunology and Medical Microbiology. 2007;51(3):517-525. doi:10.1111/j.1574-695X.2007.00331.x.

13. Nazila J, Husnudin UB, Ihsan M, Hariyadi B, Maritsa HU. The diversity of terrestrial ferns in the Customary Forest of Depati Karo Jayo Tuo, Jambi. Al-Hayat: Journal of Biology and Applied Biology. 2024;7(2):177-189. doi:10.21580/ah.v7i2.23967.

14. Pagare S, Bhatia M, Tripathi N, Pagare S, Bansal YK. Secondary metabolites of plants and their role: overview. Current Trends in Biotechnology and Pharmacy. 2015;9(3):293-304.

15. Vetter J. Secondary metabolites of ferns. In: Fernández H, editor. Current Advances in Fern Research. Cham: Springer; 2018. doi:10.1007/978-3-319-75103-0_15.

16. Chikmawati T, Sopyati PD, Miftahudin. Pertumbuhan dan analisis kualitatif tanin, saponin dan flavonoid dari Selaginella plana, S. willdenovii, and S. mayeri pada tiga naungan berbeda. Jurnal Bioslogos. 2013;3(1):1-9.

17. Abedelmaksoud TG, Younis MI, Altemimi AB, Tlay RH, Ali Hassan N. Bioactive compounds of plant-based food: extraction, isolation, identification, characteristics, and emerging applications. Food Science & Nutrition. 2025;13:e70351. doi:10.1002/fsn3.70351.

18. Utami YP, Arruansaratu E, Jumaetri F. Analisis kadar total alkaloid dari beberapa ekstrak daun patikala (Etlingera elatior (Jack) R.M. Smith). Prosiding Seminar Nasional Kefarmasian "Metabolomics in Pharmacy: Peluang dan Tantangan Kefarmasian dalam Penemuan, Pengembangan, dan Evaluasi Mutu Obat Bahan Alam". Manado; 2022. p. 1-6.

19. Amalia R, Anggarani MA. Analisis kadar fenolik, flavonoid dan aktivitas antioksidan umbi bawang bombai (Allium cepa L.). UNESA Journal of Chemistry. 2022;11(1):34-45.

20. Agustina W, Nurhamidah, Handayani D. Skrining fitokimia dan aktivitas antioksidan beberapa fraksi dari kulit batang jarak (Ricinus communis L.). ALOTROP Jurnal Pendidikan dan Ilmu Kimia. 2017;1(2):117-122.

21. Hanifah NI, Wirasisya DG, Muliani AE, Utami SB, Sunarwidhi AL. Phytochemical screening of decoction and ethanolic extract of Amomum dealbatum Roxb. leaves. Jurnal Biologi Tropis. 2021;21(2):510-518. doi:10.29303/jbt.v21i2.2758.

22. Virtbauer J, Kählig H, Hüfner A, Donath O, Marian B. Chemical and pharmacological investigations of Metaxya rostrata. Zeitschrift für Naturforschung C. 2008;63(7-8):469-475. doi:10.1515/znc-2008-7-801.

23. Kurniawati IF, Sutoyo. Review artikel: potensi bunga tanaman sukun (Artocarpus Altilis [Park. I] Fosberg) sebagai bahan antioksidan alami. UNESA Journal of Chemistry. 2021;10(1):1-11.

24. Faizal A, Taufik I, Rachmani AF, Azar AWP. Short communication: antioxidant and antibacterial properties of tree fern Cyathea contaminans. Biodiversitas. 2020;21(5):2201-2205. doi:10.13057/biodiv/d210548.

25. Dia SPS, Nurjanah, Jacoeb AM. Komposisi kimia dan aktivitas antioksidan akar, kulit batang dan daun lindur. Jurnal Pengolahan Hasil Perikanan Indonesia. 2015;18(2):205-219. doi:10.17844/jphpi.2015.18.2.205.