MJFAS
Malaysian Journal of Fundamental and Applied Sciences

Astuti *et al.* | Malaysian Journal of Fundamental and Applied Sciences, Vol. 19 (2023) 215-218

RESEARCH ARTICLE

The Antioxidant Activity and Total Phenolic Content of *Sonneratia ovata* Back

Maria Dewi Astuti*, Kholifatu Rosyidah, Dewi Umaningrum, Ratna Ardiyanti, Hanan Johan Abd. Rasyied, Aisyah Puteri Azzahra

Department of Chemistry, Faculty of Mathematics and Natural Science, Lambung Mangkurat University, Indonesia

Abstract The antioxidant activity and total phenolic content of *Sonneratia ovata* Back, a mangrove plant, were investigated in this study. Methanol was used to extract the leaf, fruit, stem bark, and root of *S. ovata* Back. The antioxidant assay was conducted using the scavenging radical DPPH, and the total phenolic content was measured following the Folin Ciaocalteu method. Methanol extract from leaves of *S. ovata* Back presented the highest antioxidant activity than stem bark, root, and fruit. The IC_{50} were 4.07 mg/L, 25.94 mg/L, 100.94 mg/L, and 195.83 mg/L, respectively. The total phenolic content of leaf (52.00 mgGAE/g) was higher than fruit (14.06 mgGAE/g). This study suggested that the methanolic leaf extract of *S. ovata* Back contained a potential source of natural antioxidants more than the other parts.

Keywords: *Sonneratia ovata*, DPPH, phenolic, leaf, stem bark.

Introduction

Free radicals can be produced by the body as a result of cell metabolism products or external exposure to food, sunlight, cigarette smoke, or air pollution. Excessive quantities of free radicals can induce oxidative stress and excessive oxidation processes. It can lead to cell damage and diseases like diabetes, atherosclerosis, cancer, heart disease, cataracts, premature aging, hypertension, inflammation, liver diseases, Alzheimer's, Parkinson's, and other degenerative diseases [1, 2]. Antioxidants are essential for preventing the destructive effects of free radicals. Carotenoids, phenolics, flavonoid groups (including flavones, anthocyanins, and their derivatives), unsaturated fatty acids, vitamins, enzymes, and cofactors are only a few of the antioxidant substances found in plants that can scavenge free radicals. These compounds may be beneficial in maintaining health and treating or preventing disease [3]. Therefore, the exploration of natural antioxidants is needed to scavenge free radicals.

***For correspondence:**
mdastuti@ulm.ac.id

Received: 29 Oct. 2022
Accepted: 15 Feb. 2023

Sonneratiaceae contains nine species of mangrove plants, including *S. apetala, S. caseolaris, S. gulngai, S. griffithii, S. lanceolata, S. alba*, and *S. ovata* [4]. Traditional medicine has utilized *Sonneratia* plants to treat asthma, fever, hepatitis, sprains, febrifuge, ulcers, and hemorrhages [5]. *S. ovata* Back grows natively on the coast of Kotabaru, South Kalimantan, Indonesia.

Many researchers have recently discovered chemical compounds such as phenolic and its derivate, phenolic acid and its derivate, steroid, triterpenoid, lignan, and cerebroside from *S. ovata* fruit and leaves [6, 7]. β-sitosterol & stigmasterol were isolated from the stem bark of *S. ovata* [8]. In our previous work, phytochemical screening revealed that the root, stem bark, leaf, and fruit of *S. ovata* Back contained saponins and flavonoids. In contrast, the root, stem bark, and leaf contained alkaloids and tannins. Carotenoid has been discovered in the leaves, stem bark, and fruit [9, 10]. Some of these compounds were considered to have antioxidant activity. Phenolic compounds play a role in antioxidant activity [14]. Numerous studies have discussed the antioxidant activity and total phenolic in *Sonneratia* plants, such as *S. alba* [11], *S. apetala* [12], and *S. caseolaris* [13, 15, 16, 17]. However, to the best of our knowledge, no research has been conducted on the antioxidant activity and phenolic content of *S. ovata* Back.

10.11113/mjfas.v19n2.2789

Therefore, this study aimed to determine the antioxidant activity and total phenolic content of the methanolic extract of *S. ovata* Back.

Materials and Methods

Chemicals

DPPH (2,2-Diphenyl-1-Picrylhydrazil), quercetin, and gallic acid were purchased from Sigma-Aldrich. Methanol p.a (pro analysis), Folin Ciaocalteu, and Natrium carbonate were obtained from Merck. Methanol technical quality was bought from Jong Java Store.

Samples Preparation

The stem bark, root, leaf, and fruit of *S. ovata* were collected from Kotabaru district, South Kalimantan, Indonesia. The plant was identified by an expert from Biology Laboratory at Muhammadiyah University Surakarta, Indonesia. The samples were ground into powder after being air dried at room temperature. The powder of stem bark (500 g), fruit (300 g), and leaf (500 g) was separately macerated with 1.5 L of methanol for 24 hours, while the powder of root (50 g) was macerated with 1 L methanol. Extraction was repeated three times successively. The methanol-soluble parts of the stem bark, root, leaf, and fruit of *S. ovata* were separately concentrated on a rotary vacuum evaporator. A water bath was then followed to produce the solid mass of stem bark extract (21.55 g), fruit extract (19.99 g), leaf extract (50.78 g), and root extract (5.53 g). The yield (%) was calculated based on the following equation:

$$Yield\ (\%) = \frac{\text{mass of crude extract (g)}}{\text{mass of fine powder (g)}} x100 \quad (1)$$

Determination of Antioxidant Activity

An antioxidant activity assay was carried out based on scavenging free radicals of DPPH (2,2-diphenyl-picrylhidrazyl) according to the modified method described [18]. Briefly, 2-10 mg/L (leaf extract), 15-75 mg/L (fruit extract), 20-140 mg/L (root extract), and 10-50 mg/L (stem bark extract) were prepared with methanol p.a as a solvent. In a flask, 2 mL of each extract solution or standard chemical was mixed with 2 mL of DPPH 0.15 mM. The mixture was vortexed and left at room temperature in the darkroom for 30 minutes. The absorbance was measured at 516 nm using a UV spectrophotometer (GENESYS 10S) with methanol p.a as a blank. The control contained methanol and DPPH. Quercetin was used as a positive control/standard compound (0-10 ppm).

The scavenging of free radical DPPH was calculated based on the following equation:

$$Inhibiton\ of\ free\ radicals\ (\%) = \frac{\mathrm{A0-As}}{\mathrm{A0}} x100 \quad (2)$$

A_0 is the absorbance of the control reaction. A_s is the absorbance of solutions with the sample extract or standard. The IC_{50} is the inhibition concentration that could scavenge 50% DPPH. The IC_{50} value for each extract was graphically determined by plotting the inhibition of free radical DPPH percentage (y-axis) and extract concentration (x-axis).

Determination of Total Phenolic Content

Total phenolic content was determined by modifying the Folin Ciocalteu method as described [19]. For each sample (leaf and fruit extract), 0.5 mL of methanol solution of leaf or fruit was mixed with 0.5 mL of Folin-Ciocalteu reagent, 4 mL Na_2CO_3 1 M, and 5 mL aquades. The tubes were placed in a 45°C water bath for 5 minutes before being placed in a cold water bath. The absorbance was measured at 765 nm using a UV spectrophotometer (GENESYS 10S). Gallic acid was used as a standard curve (50-90 ppm). The total phenolic contents of each extract were expressed as gallic acid equivalents (mg GAE/g extract).

Results and Discussion

The stem bark, leaf, root, and fruit of *S. ovata* Back were employed in this study. Table 1 summarizes the yield % of methanol extract in various parts of the plant. The result of the extract varied from 4.31% to 11.06%. The highest yield was found in the root (11.06%). The percentage of yield in extraction is determined by the type of plant components, and extractant used [17].

Table 1. Yield (%) of methanol extract from various parts of *S. ovata* Back

Extract	Yield (%)
Stem bark	4.31
Leaf	10.16
Fruit	6.66
Root	11.06

Antioxidant activities of various part *S. ovata* Back was determined by the DPPH method. The result was presented in Table 2.

Table 2. DPPH radical scavenging activities *S. ovata* Back

Extract	IC_{50} (mg/L)
Stem bark	25.94
Leaf	4. 07
Fruit	195.83
Root	100.94
Quercetin	4.36

The antioxidant activity (IC_{50}) of all extracts ranged from 4.07 to 195.83 mg/mL (Tabel 2). The leaf extract of *S. ovata* has a very strong antioxidant activity against DPPH radicals (IC_{50} 10 mg/L) [20], whereas the stem bark extract has a strong activity (IC_{50} 10-50 mg/L) [20]. The other test revealed that the root and fruit of *S. ovata* had low antioxidant activity (IC_{50} 100-250 mg/L) [20]. The leaf methanol extract has the highest antioxidant content, followed by the stem bark, root, and fruit. The data experiment revealed that the IC_{50} of *S. ovata* Back leaf was comparable to that of conventional quercetin. It indicates that the leaf of *S. ovata* has a high potential as a natural antioxidant source. The antioxidant activity of *S. ovata* Back stem bark, fruit, and root was lower than quercetin as a standard chemical.

The IC_{50} value was reported on another *Sonneratia* species. The IC_{50} of a methanol extract of *S. alba* leaf was 0.038 mg/mL [11]. The IC_{50} for *S. caseolaris* young leaf was 13,9915 mg/L [21]. Pericarp and seed of *S. caseolaris* had IC_{50} 117 ± 11 mg/L and 16 ± 3 mg/L, respectively [13]. There were only a few studies on the antioxidant activity of *Sonneratia root*. The root of S. alba has the potential to scavenge DPPH by 40.70% [14]. Methanol extract of *S. alba* bark had IC_{50} of 0.0025 ± 0.003 mg/L [11].

Table 3. Total phenol content *S. ovata* Back

Samples	Total Phenol (mg GAE/g)
Leaf	52.00
Fruit	14.06

Table 3 shows that the total phenolic content of *S. ovata* Back leaf extract and fruit extract was 52.00 mg GAE/g and 14.06 mg GAE/g extract, respectively. The leaf has a higher total phenolic content than the fruit. The leaf of *S. ovata* Back exhibited stronger antioxidant activity and a higher total phenolic content. It is pertinent to *Rhizophora stylosa* and *S. alba*, the mangrove plants with the highest antioxidant activity and phenolic content [14].

The total phenolic content in other *Sonneratia* plants has been reported, and the values were varied. The leaf of *S. alba* was 216.53 ± 3.09 mg GAE/g extract [11] and 8.27 ± 1.13 mg/g [14]. The total phenol content of fruit *S. alba* was 29.18 mg TAE/g extract [16], whereas pericarp and seed of *S. caseolaris* had total phenolic content of 20.4 ± 0.2 mg GAE/g and 103.9 ± 0.8 mg GAE/g [13], respectively.

Conclusion

The antioxidant content of *S. ovata* leaf extract was higher than that of the stem bark, root, and fruit extracts, with an IC_{50} of 4.07 mg/L and a total phenolic content of 52.00 mg GAE/g. According to this study, the methanolic leaf extract of *S. ovata* Back possessed a higher potential source of natural antioxidants than the others.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgment

This work is part of a research project, Dosen Wajib Meneliti 2022, with contract number: 024. 111/UN8.2/PL/2022 supported by DIPA Fund Lambung Mangkurat University.

References

[1] Rodrigo, R. (2009). *Oxidative stress and antioxidants: Their role in human diseases*. Nova: New York, NY, USA.

[2] Flieger, J., Flieger, W., Baj, J., Maciejewski, R., Maciejewski, R. (2021). Antioxidants: classification, natural sources, activity/capacity measurements, and usefulness for the synthesis of nanoparticles. *Materials, 14*, 4135.

[3] Munteanu, I. G. & Apetrei, C. (2021). Analytical methods used in determining antioxidant activity: A review. *Int. J. Mol. Sci*., *22*, 3380.

[4] Duke, N. C. (2006). *Australia's mangroves. The authoritative guide to Australia's mangrove plants*. University of Queensland, Brisbane.

[5] Bandaranayake, W. M. (2002). Bioactivities, bioactive compounds and chemical constituents of mangrove plants. *Wetlands Ecology and Management*, *10*, 421-452.

[6] Wu, S. B., Wen,Y., Li, X. W., Zhao, Y., Zhao, Z., Hu, J. F. (2009). Chemical constituents from the fruits of *Sonneratia caseolaris* and *Sonneratia ovata* (Sonneratiaceae). *Biochemical Systematics and Ecology, 37*, 1-5.

[7] Nguyen, T. H. T., Pham, H. V. T., Pham, N. K. T., Quach, N. D. P., Pudhom, K., Hansen, P. E., Nguyen, K. P. P. (2015). Chemical constituents from *sonneratia ovata* backer and their in vitro cytotoxicity and acetylcholinesterase inhibitory activities. *Bioorganic & Medicinal Chemistry Letters, 25*, 2366-2371.

[8] Nurmalasari, F., T. Ersam, S. Fatmawati. (2016). Isolasi senyawa antioksidan dari kulit batang *sonneratia ovata* backer. *Jurnal Sains dan Seni ITS, 5*(2), 2337-3520.

[9] Astuti, M. D. & Rosyidah, K. (2020). Eksplorasi potensi tumbuhan pedada (*Sonneratia*) asal Kalimantan Selatan: Fitokimia dan bioaktivitas. Laporan Penelitian. Universitas Lambung Mangkurat.

[10] Astuti, M. D, Wulandari, M., Rosyidah, K., Nurmasari, R. (2021). Proxymate and phytochemical analysis pedada fruit (*sonneratia ovata* back.). *Jurnal Sains dan Terapan Kimia, 15*(2), 154-163.

[11] Haq, I., Hossain, A. B. M. S., Khandaker, M. M., Merican, A. F., Faruq, G., Boyce, A. N., Azirun, M. S. (2014). Antioxidant and antibacterial activities of different extracts and fractions of a mangrove plant-*Sonneratia alba. International Journal of Agriculture and Biology*, *14*, 707-714.

[12] Hossain, S. J., M. Iftekharuzzaman, M. A. Haque, B. Saha, M. Moniruzzaman, M. M. Rahman & H. T. Hossain. (2015). Nutrient compositions, antioxidant activity and common phenolics of *sonneratia apetala* (Buch.-Ham.) Fruit*. International Journal of Food Properties, 19*(5), 1080-1092.

[13] Lee, J. T. J., Adasuriyya, I., Dely, A., Ramanayake, M., Ginjom, I. R. (2016). Phenolic contents and antioxidant activities of *Sonneratia caseolaris*. *Proceeding 2nd International Conference on Sustainable Global Agriculture and Food (ICSAF),* Semarang, 9-10th August 2016.

[14] Suh, S. S., Hwang, J., Park, M., Park, H. S., Lee, T. K. (2014). Phenol content, antioxidant and tyrosinase inhibitory activity of mangrove plants in Micronesia*. Asian Pacific Journal of Tropical Medicine,* 531-535.

[15] Monira, S., Islam, A., Islam, S., Koly, S. F., Nesa, L., Muhit, A. (2019). Phytochemical screening and comparative antioxidant activities of fractions isolated from *Sonneratia caseolaris* (Linn.) Bark Extracts. *European Journal of Medicinal Plants, 28*(4), 1-9.

[16] Santoso, J., Febrianti, F., Nurjanah. (2011). Phenol content, phytochemical composition, and antioxidant activity of the pedada fruits *sonneratia caseolaris*. *Jurnal Ilmu dan Teknologi Pangan*, *9*(1), 1-10.

[17] Wetwitayaklung, P., Limmavapirat, C., Phaechamud, T. (2013). Antioxidant and anticholinesterase activities in various parts of *sonneratia caseolaris* (L.). *Indian Journal of Pharmaceutical Sciences*, Nov-Dec 2013, 649-656.

[18] Molyneux, P. (2004). The use of the stable free radical diphenylpicrylhydrazyl (DPPH) for estimating antioxidant activity. *Songklanakarin. J. Sci. Technol*., *26*(2), 211-219.

[19] Tlili, N., Elfalleh, W., Hannachi, H., Yahia, Y., Khaldi, A., Ferchichi, A., Nasri, N. (2013). Screening of nature antioxidants from selected medical plants*. International Journal of Food Properties*, *16*(5), 1117-1126.

[20] Phongpaichit, S., Hutadilok-Towatana, N., Nikom, J., Rungjindamai, N., Sakayaroj, J., Rukachaisirikul, V., Kirtikara, K. (2007). Biological activities of extracts from endophytic fungi isolated from *Garcinia plants*. *FEMS Immunol Med Microbio*l, *51*, 517-525.

[21] Winarti, Rahardja, B. S., Sudarno. (2019). Antioxidant activity *Sonneratia caseolaris* leaves extract at different maturity stages. *Jurnal of Marine and Coastal Science*, *8*(3), 130-138.