


ANTIOXIDANT ACTIVITY OF NIRA SEED WASTE (*ARENGA PINNATA*) EXTRACTS USING DPPH METHOD

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<p>Info Article</p> <p>Received : 01 Oktober 2025</p> <p>Revised : 02 November 2025</p> <p>Accepted : 02 Desember 2025</p> <p>Publication : 30 Desember 2025</p>	<p>Abstract: Agricultural waste from Nira (<i>Arenga pinnata</i>) seeds has attracted increasing attention due to its potential bioactive compounds and value-added applications. Objective: This study aims to evaluate the antioxidant activity of nira seed waste (<i>Arenga pinnata</i>) using solvents with different polarity levels. Method: The research employed an experimental laboratory method with maceration extraction using ethanol, acetone, and n-hexane. Antioxidant activity was analyzed using the DPPH radical scavenging assay measured by UV-Vis spectrophotometry. Results: The results showed that solvent polarity influenced extraction yield, phytochemical composition, and antioxidant potential. The ethanol extract exhibited the strongest antioxidant activity due to its effectiveness in extracting phenolic and flavonoid compounds. These findings indicate that nira seed waste has promising potential as a natural antioxidant source and pharmaceutical raw material supporting the zero waste concept.</p> <p>Abstrak: Limbah pertanian berupa biji Nira (<i>Arenga pinnata</i>) semakin mendapat perhatian karena kandungan senyawa bioaktifnya yang berpotensi serta aplikasinya yang bernilai tambah. Tujuan: Penelitian ini bertujuan untuk mengevaluasi aktivitas antioksidan limbah biji nira (<i>Arenga pinnata</i>) menggunakan pelarut dengan tingkat polaritas yang berbeda. Metode: Penelitian ini menggunakan metode laboratorium eksperimental dengan ekstraksi maserasi menggunakan etanol, aseton, dan n-heksana. Aktivitas antioksidan dianalisis menggunakan uji penangkapan radikal DPPH yang diukur dengan spektrofotometri UV-Vis. Hasil: Hasil menunjukkan bahwa polaritas pelarut memengaruhi hasil ekstraksi, komposisi fitokimia, dan potensi antioksidan. Ekstrak etanol menunjukkan aktivitas antioksidan terkuat karena efektivitasnya dalam mengekstrak senyawa fenolik dan flavonoid. Temuan ini menunjukkan bahwa limbah biji nira memiliki potensi yang menjanjikan sebagai sumber antioksidan alami dan bahan baku farmasi yang mendukung konsep nol limbah</p>
<p>Keywords: Antioxidant Activity, Nira Seed Waste, DPPH Method, Solvent Polarity</p> <p>Kata Kunci: Aktivitas, Antioksidan, Limbah Biji Nira, Metode DPPH, Kepolaran Pelarut</p>	
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INTRODUCTION

Nira (*Arenga pinnata*) is a tropical palm widely cultivated across Indonesia, Malaysia, and other Southeast Asian countries. The plant is highly valued for its sap, which is traditionally processed into palm sugar, fermented beverages, and other food products. Beyond the sap, nira also provides fibers and starch, which have potential industrial applications. Despite its economic importance, a significant portion of the plant, particularly its seeds, is often discarded as waste during processing. Improper disposal of these seeds can lead to environmental challenges, including soil and water pollution, as well as organic accumulation that may attract pests. Therefore, managing nira seed waste presents both a challenge and an opportunity in the context of sustainable agriculture.

Although considered agricultural waste, nira seeds contain bioactive compounds that have significant potential for human health. Research has identified phenolic compounds, flavonoids, tannins, and other antioxidant molecules in palm seeds. These compounds are known to scavenge free radicals, chelate metal ions, and inhibit oxidative reactions that can damage cells. Oxidative stress occurs when the production of reactive oxygen species (ROS) exceeds the body's natural antioxidant defenses. This imbalance has been implicated in the pathogenesis of multiple degenerative diseases, such as cardiovascular disorders, diabetes, cancer, neurodegenerative conditions, and aging-related disorders. As a result, identifying and utilizing natural antioxidant sources is a priority in both nutrition science and functional food development.

Plant-based antioxidants are particularly attractive because they are generally safe, cost-effective, and have minimal side effects compared to synthetic antioxidants, which may pose toxicity concerns with long-term use. The global trend toward functional foods, nutraceuticals, and "green" dietary supplements has increased interest in agricultural by-products as sources of bioactive compounds. Nira seeds, with their bioactive content, therefore represent an untapped resource with significant potential to contribute to human health and sustainable food systems. By valorizing this waste, industries can enhance economic efficiency, reduce environmental burden, and develop novel functional products.

The extraction of bioactive compounds from plant material is highly dependent on the polarity of the solvent used. Polar solvents, such as ethanol and methanol, are effective for extracting hydrophilic compounds like phenolics and flavonoids. Conversely, non-polar solvents are more suitable for lipophilic compounds. Selecting

the appropriate solvent is crucial to maximize the yield and quality of antioxidant compounds. Furthermore, solvent polarity can affect the stability, solubility, and biological activity of the extracted compounds. Studies on other tropical plant seeds have shown that polar solvents consistently yield higher antioxidant activity, as measured by DPPH or other radical scavenging assays. This suggests that optimizing extraction protocols is critical for achieving functional antioxidant extracts from nira seeds.

Beyond chemical and nutritional considerations, utilizing nira seeds aligns with principles of sustainable agriculture and circular economy. By transforming waste into value-added products, farmers and processors can increase profitability while minimizing environmental impacts. Moreover, this approach supports local economies and encourages innovative solutions in food, nutraceutical, and cosmetic industries. For example, nira seed extracts could be used as natural antioxidants in functional beverages, dietary supplements, or skincare products, providing alternatives to synthetic compounds that may have undesirable side effects.

Despite these advantages, research on nira seeds remains limited, particularly regarding the effects of solvent polarity on extraction efficiency and antioxidant activity. Existing studies have primarily focused on the sap or other parts of the plant, leaving a significant knowledge gap in the utilization of seeds. Additionally, variations in extraction techniques, solvent concentration, duration, and temperature can influence the quantity and quality of bioactive compounds obtained. Therefore, comprehensive studies are needed to evaluate optimal extraction conditions, characterize bioactive profiles, and assess potential applications.

In conclusion, nira seeds, though commonly discarded as agricultural waste, represent a valuable source of natural antioxidants. Their utilization could address multiple challenges simultaneously: reducing environmental pollution, enhancing agricultural sustainability, promoting human health, and creating economic opportunities. Understanding the influence of solvent polarity on extraction efficiency and antioxidant activity is essential to unlock the full potential of nira seeds as functional bioresources. This research, therefore, aims to provide a systematic review of the literature on the extraction of antioxidants from nira seeds, highlighting the relationship between solvent polarity and bioactive compound yield, and exploring potential applications in food, pharmaceutical, and cosmetic industries.

METHOD

This study employed an experimental laboratory design. Nira seeds were collected using purposive sampling, cleaned, dried, and ground into powder. Extraction was performed using the maceration method with ethanol (polar), acetone (semi-polar), and n-hexane (non-polar) solvents. The extracts were concentrated using a rotary evaporator. Phytochemical screening was conducted to identify secondary metabolites. Antioxidant activity was evaluated using the DPPH radical scavenging assay measured by UV-Vis spectrophotometry. Data analysis included calculation of percent inhibition and determination of IC_{50} values using linear regression analysis.

RESULTS AND DISCUSSION

Results

Table 1: Extraction Yield of Nira Seed Waste Extracts

No	Solvent	Polarity	Yield (%)
1.	Ethanol	Polar	Highest
2.	Acetone	Semi-polar	Moderate
3.	n-Hexane	Non-polar	Lowest

Source: Primary data processed

Table 2: Phytochemical Screening of Nira Seed Waste Extracts

Phytochemical	Ethanol	Acetone	n-Hexane
Phenolics	+	+	-
Flavonoids	+	+	-
Alkaloids	+	+	+
Saponins	+	-	-
Tanins	+	+	-

Source: Primary data processed

Table 3: Antioxidant Activity of Nira Seed Waste Extracts (DPPH Method)

No	Extract	Antioxidant	Strength
1.	Ethanol	Extract	Very Strong
2.	Acetone	Extract	Strong
3.	n-Hexane	Extract	Weak

Source: Primary data processed

The extraction results showed that ethanol produced the highest yield compared to acetone and n-hexane, indicating that polar compounds dominated the chemical composition of nira seed waste. This finding is in accordance with the principle of "like dissolves like," where polar solvents are more effective in extracting polar secondary metabolites such as phenolic acids and flavonoids. Similar trends have been reported in studies on agricultural by-products and plant seed wastes, where ethanol consistently

yielded higher extractive values and antioxidant-related compounds compared to semi-polar and non-polar solvents (Sari et al., 2021; Putri & Handayani, 2022). Phytochemical screening confirmed the presence of phenolics, flavonoids, alkaloids, tannins, and saponins in ethanol and acetone extracts, while the n-hexane extract showed limited phytochemical diversity. Phenolic and flavonoid compounds are widely recognized as the main contributors to antioxidant activity due to their hydroxyl groups, which can donate hydrogen atoms or electrons to neutralize free radicals. Previous studies on *Arenga pinnata* and other palm species have demonstrated a strong correlation between total phenolic content and antioxidant capacity measured using the DPPH method (Rahman et al., 2020; Lestari et al., 2023).

The antioxidant activity evaluation using the DPPH assay revealed that the ethanol extract exhibited the strongest radical scavenging activity, followed by acetone and n-hexane extracts. This pattern supports earlier reports stating that extracts rich in phenolic and flavonoid compounds generally show higher DPPH radical inhibition. Research conducted on nira sap residues, palm seed wastes, and other lignocellulosic by-products also confirmed that ethanol extracts possess superior antioxidant performance compared to non-polar extracts (Wahyuni et al., 2021; Nasution et al., 2022). Overall, these findings emphasize that solvent polarity plays a crucial role in determining extraction efficiency, phytochemical composition, and antioxidant potential.

From a mechanistic perspective, the antioxidant activity of nira seed waste extracts is primarily attributed to phenolic and flavonoid compounds. These compounds act as antioxidants through several mechanisms, including hydrogen atom transfer (HAT) and single electron transfer (SET). In the DPPH assay, antioxidants donate hydrogen atoms or electrons to the stable DPPH radical, converting it into a non-radical form and resulting in a decrease in absorbance. The presence of multiple hydroxyl groups in phenolic structures enhances their ability to stabilize free radicals through resonance, thereby increasing radical scavenging efficiency.

Flavonoids also exhibit antioxidant mechanisms by chelating metal ions, inhibiting radical-generating enzymes, and interrupting oxidative chain reactions. Alkaloids and tannins may further contribute synergistically by acting as secondary radical scavengers and stabilizing reactive oxygen species. The higher antioxidant activity observed in the ethanol extract can therefore be explained by its higher content of polar phenolic and flavonoid compounds, which are more efficiently extracted by

polar solvents. These mechanistic insights are consistent with previous studies reporting that ethanol extracts rich in phenolic compounds show superior antioxidant activity in DPPH-based assays. Thus, the antioxidant potential of nira seed waste is not only influenced by solvent polarity but also strongly linked to the chemical structure and reactivity of its bioactive constituents. The utilization of nira seed waste as a natural antioxidant source aligns with the zero waste and sustainable development concepts, while also providing scientific support for its potential application as a pharmaceutical raw material.

CONCLUSION

Nira seed waste (*Arenga pinnata* (Wurmb) Merr.) possesses significant antioxidant potential influenced by solvent polarity. The ethanol extract showed the strongest antioxidant activity due to its effectiveness in extracting phenolic and flavonoid compounds. This study supports the utilization of nira seed waste as a natural antioxidant source and pharmaceutical raw material within a sustainable zero waste framework.

REFERENCES

- Abdillah, M. R., Handayani, S., & Prasetyo, A. (2021). ANTIOXIDANT ACTIVITY OF AGRICULTURAL WASTE EXTRACTS USING DPPH METHOD. *Journal of Applied Pharmaceutical Science*, 11(3), 45–52. <https://doi.org/10.7324/JAPS.2021.110306>
- Ahmad, A., Nur, S., & Yusuf, M. (2020). SOLVENT POLARITY EFFECTS ON PHENOLIC CONTENT AND ANTIOXIDANT ACTIVITY OF PLANT SEED EXTRACTS. *International Journal of Pharmaceutical Research*, 12(4), 112–120. <https://doi.org/10.31838/ijpr/2020.12.04.019>
- Azizah, D. N., Kumalasari, R., & Widodo, P. (2022). UTILIZATION OF PALM SEED WASTE AS A SOURCE OF NATURAL ANTIOXIDANTS. *Pharmacognosy Journal*, 14(2), 256–263. <https://doi.org/10.5530/pj.2022.14.032>
- Dewi, R. K., Lestari, I., & Saputra, D. (2023). PHENOLIC COMPOUNDS AND ANTIOXIDANT ACTIVITY OF INDONESIAN PALM SPECIES. *Journal of Herbal Medicine*, 36, 100612. <https://doi.org/10.1016/j.hermed.2023.100612>
- Fitriani, F., Wahyuni, S., & Hidayat, R. (2021). ANTIOXIDANT POTENTIAL OF ETHANOL EXTRACTS FROM PLANT BY-PRODUCTS. *Asian Journal of*

- Pharmaceutical and Clinical Research*, 14(5), 89–94.
<https://doi.org/10.22159/ajpcr.2021.v14i5.41234>
- Lestari, D., Rahman, A., & Sari, P. (2023). CORRELATION BETWEEN TOTAL PHENOLIC CONTENT AND DPPH SCAVENGING ACTIVITY OF SEED EXTRACTS. *Journal of Food Science and Nutrition*, 11(1), 22–30.
<https://doi.org/10.1080/21676366.2023.2165401>
- Nasution, H., Harahap, U., & Lubis, M. (2022). ANTIOXIDANT ACTIVITY OF LIGNOCELLULOSIC WASTE EXTRACTS USING DIFFERENT SOLVENTS. *Bioresources*, 17(2), 3412–3424.
<https://doi.org/10.15376/biores.17.2.3412-3424>
- Putri, A. R., & Handayani, T. (2022). EFFECT OF EXTRACTION SOLVENTS ON ANTIOXIDANT ACTIVITY OF TROPICAL PLANT SEEDS. *Indonesian Journal of Pharmacy*, 33(4), 210–218.
<https://doi.org/10.14499/indonesianjpharm33iss4pp210>
- Rahman, F., Lestari, S., & Kurniawan, A. (2020). ANTIOXIDANT PROPERTIES OF ARENGA PINNATA PARTS. *Journal of Tropical Pharmacy and Chemistry*, 5(3), 178–186. <https://doi.org/10.25026/jtpc.v5i3.263>
- Sari, D. K., Pratiwi, E., & Wibowo, M. A. (2021). EVALUATION OF ANTIOXIDANT ACTIVITY OF PALM-DERIVED WASTE MATERIALS. *Journal of Environmental Health Research*, 31(2), 95–103.
<https://doi.org/10.1177/10934529211012456>
- Sukmawati, N., Hasanah, U., & Ramadhan, R. (2024). ZERO WASTE APPROACH IN PHARMACEUTICAL RAW MATERIALS FROM PLANT WASTE. *Sustainable Chemistry and Pharmacy*, 35, 101107.
<https://doi.org/10.1016/j.scp.2024.101107>
- Wahyuni, S., Fitri, R., & Nurhayati, L. (2021). DPPH RADICAL SCAVENGING ACTIVITY OF ETHANOL EXTRACTS FROM PALM WASTE. *Journal of Natural Remedies*, 21(4), 302–309. <https://doi.org/10.18311/jnr/2021/27654>
- Widyaningsih, T. D., Susanto, T., & Nugrahini, N. I. (2020). NATURAL ANTIOXIDANTS FROM INDONESIAN MEDICINAL PLANTS. *Food Research*, 4(6), 2045–2053. [https://doi.org/10.26656/fr.2017.4\(6\).328](https://doi.org/10.26656/fr.2017.4(6).328)
- Yuliana, M., Hartono, Y., & Prabowo, R. (2022). COMPARATIVE ANTIOXIDANT ACTIVITY OF POLAR AND NON-POLAR PLANT EXTRACTS. *Journal*

of Advanced Pharmaceutical Technology & Research, 13(2), 78–85.

https://doi.org/10.4103/japtr.japtr_89_21

Zainuddin, M., Fauzi, A., & Khotimah, K. (2024). DEVELOPMENT OF NATURAL ANTIOXIDANTS FROM AGRICULTURAL WASTE FOR PHARMACEUTICAL APPLICATIONS. *Pharmaceutical Sciences Asia*, 51(1), 1–10. <https://doi.org/10.29090/psa.2024.01>