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Review Article

A literature review on ethnobotanical, phytochemical, and pharmacological properties of *Adonidia merrillii* (Becc.) Becc.

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Abstract

This paper presents the ethnobotanical information, phytochemical content, and pharmacological activities of *Adonidia merrillii*. Ethnobotanical studies of *A. merrillii* in several countries such as the Philippines, Nigeria, India, Malaysia, and Indonesia revealed that this palm is known as an ornamental plant and is also utilized for medicinal purposes such as diarrhea, toothache, psychostimulant, and treat malnourished. Furthermore, *A. merrillii* holds cultural significance, often being incorporated into ceremonial practices. Previous studies reported various phytoconstituents detected in fruit pericarp, leaf, kernel seed oil, and flower. The phytoconstituents are flavonoids, saponins, tannins, coumarins, phenolics, and others. Fruit pericarp and seed extract have potential against various cancer cells. The fruit pericarp methanol extract is adequate against pathogenic bacteria due to its fatty acid content in different mechanisms. Flavonoids in seed extract are used as antidiarrheal agents, and the flavonoid effectivity increases when they are combined with lactic acid probiotic bacteria. Antioxidant activity was reported obtained from the fruit and pericarp extracts. Based on ethnobotanical studies and scientific research, *A. merrillii* has great potential and can be developed as a medicine in further research.

Keywords: *Adonidia merrillii*, ethnobotany, medicinal plant, phytochemical substance.

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Introduction

Adonidia merrillii (Becc.) Becc. or *Veitchia merrillii* (Becc.) H.E. Moore is widely used as an ornamental plant due to its exotic appearance (Iyasele et al., 2022). The plant is one of the most popular ornamental plants in the world and has been widely introduced as an indoor ornamental plant, especially in the tropics. This ornamental palm can grow well with only primary care, bears many fruits, and has large inflorescences with high-quality nectar (Gutierrez, 2023).

A. merrillii is widely distributed in tropical regions (Heim, 2015) with various vernacular names in different countries (Lim, 2012; Putri & Bashri, 2019) (Table 1). *A. merrillii* was cultivated in Manila around 1875, also known as Normanbya merrillii Becc. in 1909 (Fernando, 2011). The species became known locally as the Flower of China as its fruit can substitute *Areca catechu*. The plant is known as Bunga de Jolo, indicating its true origin. However, no records show that this plant originated from Jolo Island. In 1919, *A. merrillii* became known in two locations, namely in Palawan Island and Apulit Island, Philippines. In August 1957, the name *Adonidia merrillii* was changed to *Veitchia merrillii* by H. E. Moore, Jr. (McCurrach, 1960; Fernando, 2011). *Adonidia* currently has only one species, *Adonidia merrillii* (Becc.) Becc. Cladistic analysis shows that *Adonidia*, which used to belong to the genus *Veitchia,* is in a different taxon in an isolated lineage in the subtribe Ptychospermatinae (Zona & Fuller, 1999). The details of the taxonomic position from Catalogue of Life are mentioned in Table 1.

Several studies have shown that *A. merrillii*, an ornamental plant, has potential for other uses. The local communities utilize it as food, building materials, traditional ceremonies, medicinal purposes, and others (Hussin et al., 2020; Abe & Ohtani, 2013). The local communities's knowledge about plants was discovered by an ethnobotany study (Teshome et al., 2023).

Ethnobotany comes from 'ethno', which means human, and 'botany', which means plant science. Ethnobotany is an interdisciplinary science based on botany and anthropology. The other meaning of ethnobotany is the interaction of local communities with the natural environment, including the classification, management, and use of available plants. Traditional communities utilize plants for food, medicine, fuel, shelter, cultural purposes, and religious ceremonies (Young, 2007; Ozturk & Hakeem, 2018).

Local communities developed their traditional plant utilization, management, and conservation knowledge long ago. The complex knowledge, belief systems, and practices are called indigenous or traditional knowledge or local wisdom. Local wisdom can evolve and change over space and time, with changes in resources and culture. In the field of health and medicine, ethnobotanical studies will provide good information about the benefits of plants that are widely used by communities based on local wisdom. Modern ethnobotanists strive to collect all available data on plant use and document medicinal plant biodiversity and their utilization methods to support data validity (Young, 2007; Ozturk & Hakeem, 2018; Martinez et al., 2019).

The extensive knowledge of local people about medicinal plants and their utilization is essential for developing traditional and modern medicine (Paramita et al., 2017). Many modern medicines are discovered from traditional medicinal plants (Singh et al., 2020). Therefore, interest in ethnobotanical knowledge has increased recently (Meddour & Meddour-Sahar, 2015). Ethnobotanical research was reported in several

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countries, namely Nigeria (Oderinlo et al., 2021), Morocco (Ouhaddou et al., 2020), Algeria (Madani et al., 2015; Boucherit et al., 2018), Indonesia (Paramita et al., 2017), and others.

Medicinal plants have medical agents such as bioactive phytochemical compounds and secondary metabolites (Vafaei, 2013). Natural phytochemicals produced by medicinal plants have various biological activities such as anti-bacterial, antioxidant (Ao et al., 2008), anti-viral, anti-fungal, anti-cancer, and anti-diabetes (Manoharan & Kaur, 2013). The content of bioactive phytochemicals determines the medicinal and pharmacologicl,al value of plants due to their significant effects on the physiology of the human body (Akinmoladun et al., 2007). The discipline of ethnobotany records the use of various indigenous plants as an avenue for pharmacological investigation (Gu et al., 2014). Using medicinal plant data from ethnobotanical research is an effective way to discover potential new chemicals for treatment (Paramita et al., 2017).

A. merrillii is a perennial and solitary tree plant with a height of 5-15 m (National Parks Flora and Fauna Web, 2023) (Figure 1a). The stems (Figure 1b) were light gray, smooth, 13.5-15 cm in diameter, with rings formed from circular leaf scars (Jayakumar et al., 2017).

The leaves (Figure 1c) were light green to dark green, pinnate leaf arrangement, 40-70 leaflets in one rachis, 68.5-70 cm long and 4.3-4.8 cm wide, curved upward and drooping downward, short petiole. The leaf base is between the stem and leaf blade, has a smooth texture, and has a light green crown shaft shape. The flower (Figure 1d) was 2 cm in diameter, creamy-white, unisexual, and inflorescent with a short stalk. The flower consists of three petals with a light green to white color. Stamens are ball-like shapes. The fruit (Figure 1e) was ovoid, green when unripe, red when ripe, 3 - 3.5 cm long, and 1.8 - 2 cm wide (Personal documentation). The endocarp of *A. merrillii* fruit is thin and fragile with a yellowish, dry, slightly fleshy mesocarp and thin epicarp (Lim, 2012).

Based on the explanation above, *A. merrillii* could be cultivated by people for ornamental and other purposes. People are able to utilize the beneficial purpose and develop research on the potential of this palm based on the ethnobotany usage and research about pharmacology activities, especially the potency to be developed as a medicine based on its phytochemical profile. Therefore, the ethnobotanical information, phytochemical content, and pharmacological activities of *Adonidia merrillii* (Becc.) Becc. are presented in this paper.

Table 1. Taxonomical classification and vernacular names of *Adonidia merrillii*

Taxonomical Classification		Country	Vernacular Names
Kingdom	Plantae	England	Manila Palm, Merrill Palm, Kerpis Palm, Christmas Palm, Dwarf Royal Palm
Phylum	Tracheophyta	Philippines	Oring-Oring, Bunga De Jolo, Bunga De China, Lugos
Class	Liliopsida	Malaysia	Palma Manila
Order	Arecales	Indonesia	Palem Putri
Family	Arecaceae	Thailand	Mak-Nual, Maak Nuan, Paam Nuan
Genus	*Adonidia*	Japan	Manira Yashi
Species	*Adonidia merrillii*	China	Ma Ni La Ye Zi
		Netherlands	Kertspalm
		Italy	Palma Di Manila
		Germany	Manilapalme, Weihnachtspalm
		France	Palmier Nain Royal, Palmier De Manille, Palmier Des Philippines, Palmier De Noël
		Chamorro	Pugua Chena

Methods

The research was conducted between January to October 2023. The electronic databases of Google Scholar, PubMed, and Science Direct were used in this literature review to search for references about ethnobotany, phytochemical substituents, and pharmacology activities of *A. merrillii*. References used in this research are in English or Indonesian. Keywords for searching references were *Adonidia merrillii*, *Veitchia merrillii*, ethnobotany, phytochemical compound, anticancer, antibacterial, antidiarrhea and antioxidant. *A. merrillii* classification information was obtained from the Catalogue of Life as a taxonomical database, while the plant pictures were from a self-documentary by Android camera.

Results and Discussion

Ethnobotany and traditional uses

A. merrillii is found in several countries for ethnobotanical purposes (Table 2). People of the Cebu region in the Philippines use it as a traditional medicine (Fierro, 2022). The people of Batan also use its roots, which are consumed as a drink decoction to treat diarrhea (Abe & Ohtani, 2013). The people of North

Cotabato Province also use the seeds for diarrhea treatment. The seeds of this plant are known to have benefits as psychostimulants that provide mental alertness effects (Clemen-Pascual et al., 2022). *A. merrillii* in Palawan and Negros, Philippines, is also used as an ornamental plant, usually planted by the roadside (Gutierrez, 2023), which is also used as a raw material for sugar production, vegetable oil production, and building materials. The fruits of this plant are edible fruits commonly used in the traditional ritual of buyo or eating betel (Hussin et al., 2020; Gutierrez, 2023).

Fresh leaves of *A. merrillii* treat malnourished elephants in Tamil Nadu and Puducherry, southern India. The leaf is used as elephant feed in a raw condition (Jayakumar et al., 2017). In Nigeria, *A. merrillii* is used as an ornamental plant (Antia et al., 2017) and an ornamental plant that functions as an environmental conditioner in Malaysia. In addition, the Malay community in Malaysia also utilizes the fruit in special ceremonies such as engagement ceremonies, weddings, and royal ceremonies as part of non-verbal communication. The fruit of *A. merrillii*, or buah pinang, is an essential element in tepak sirih, an ornamental object in a rectangular wooden or brass box that symbolizes good character and high noble character (Hussin et al., 2020).

A. merrillii is also widely found in Indonesia and is known as the Palem Putri. The plant is an ornamental plant at the Sumenep Palace, one of the historical tourist areas in Sumenep, Madura Island (Putri & Bashri, 2019). The fruit of *A. merrillii* is also used by the local community of Paser Regency, East Kalimantan, for toothache medicine (Hidayat et al., 2022). Several references mentioned Palem Putri as *Veitchia merrillii* (Becc.) H.E. Moore. used for various purposes in Indonesia, such as an ornamental plant in West Lombok Regency (Sulistia et al., 2021), and Pangandaran Regency, also used as a road shade. The fruit, leaves, and stems are also used for decoration (Mutaqin et al., 2016). The plant is also utilized as an ornamental plant in Telajakan, Denpasar City, Bali Island. The leaves, flowers, and fruits are used for upakara or banten in Hindu religious ceremonies (Darmadi, 2014).

Phytochemical compunds

Chemical compounds in the fruit pericarp of *A. merrillii* include phenolics, flavonoids, deoxyribose sugar, cardiac glycosides in high levels, and saponins in various levels (Essien et al., 2017). These compounds are interrelated with each other and provide benefits (Essien et al., 2017). Other parts of the *A. merrillii* plant also contain chemical compounds. The chemical compounds in the leaves include saponins, steroids, tannins, coumarins, and glycosides (Fierro, 2022).

Phytochemical screening results of *A. merrillii* kernel seed oil by Gas Chromatography-Mass Spectrometry (GC-MS) analysis showed 19 compounds (Table 3) (Figure 2), while *A. merrillii* flower essential oil by Gas Chromatography-Electron Ionization-Mass Spectrometry (GC-EI-MS) analysis showed 11 compounds (Table 4) (Figure 2).

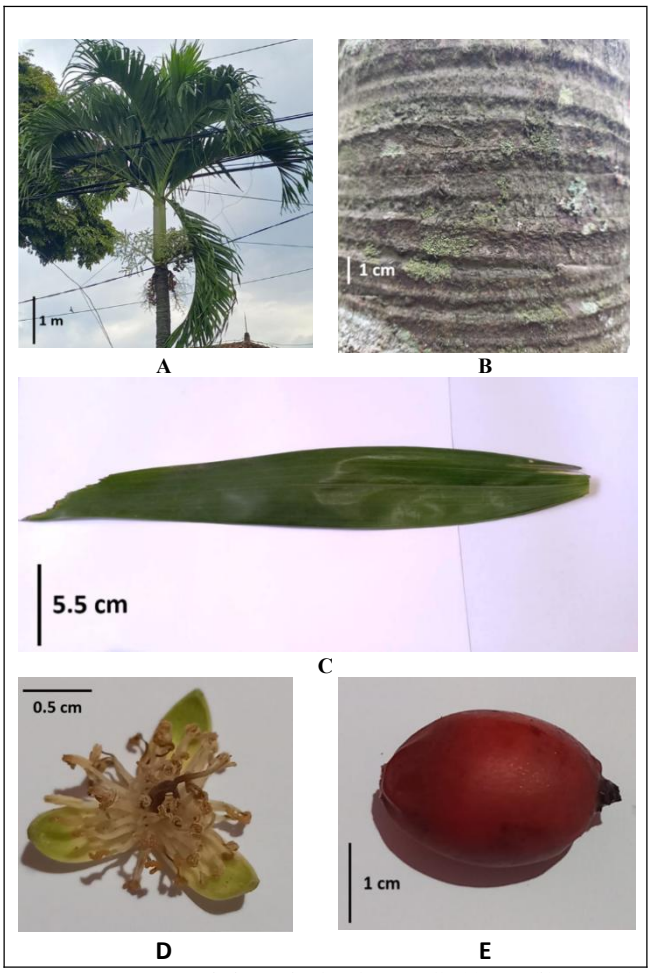

Figure 1. Gross morphology of *Adonidia merrillii* (a) tree, (b) stem, (c) leaflet, (d) flower, (e) fruit

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Table 2. Ethnobotanical Adonidia merrillii usage in different countries

Region	Country	Usage	Plant parts	References
Batan Island	Philippines	Medicinal purpose	Roots	(Abe & Ohtani, 2013)
North Cotabato Province	Philippines	Medicinal purpose	Seed	(Clemen-Pascual et al., 2022)
Cebu City	Philippines	Herbal medicine	-	(Fierro, 2022)
		Ornamental plant	Whole plant	(Gutierrez, 2023)
Palawan & Negros	Philippines	Use as a masticatory (chewing) and source of beads	Fruits	
		Raw material for sugar production, vegetable oils production, and building materials.	Not mentioned	(Hussin et al., 2020)
-	Philippines	Ornamental plant	Whole plant	
		Edible plant	Fruits and buds	
		Traditional rituals like makan sirih'/ chewing / buyo	Fruits	
Tamil Nadu and Puducherry	India	medicinal purpose for animal	Leaves	(Jayakumar et al., 2017)
-	Nigeria	Ornamental plant	Whole plant	(Antia et al., 2017)
		Ornamental plant	Whole plant	(Hussin et al., 2020)
-	Malaysia	Important element in *tepak sirih* for special ceremonies	Fruits	
-	Malaysia	Horticulture	Whole plant	(Najib et al., 2013)
Madura Island	Indonesia	Ornamental plant	Whole plant	(Putri & Bashri, 2019)
		Ornamental plant	Whole plant	(Darmadi, 2014)
Bali Island	Indonesia	Religious ceremonies	Leaves, flowers, fruits	
East Kalimantan	Indonesia	Medicinal Purpose	Fruits	(Hidayat et al., 2022)
Pangandaran	Indonesia	Ornamental plant and rodside plant	Whole plant	(Mutaqin et al., 2016)

Table 3. Chemical compounds on *Adonidia merrillii* kernel seed oil

Compounds	% composition	Approximate weight (gram)
Myristic acid	0.30	15.00
Methyl, 14-methyl pentadecanoate	13.60	680.00
Palmitic acid	16.99	849.50
Methyl Octadeca 8,11-dienoate	3.51	175.50
Oleic acid methyl ester (E)-	12.67	633.50
Methyl Octadecanoate	2.77	138.50
Linoleic acid	34.62	1731.00
Petroselinic acid	8.44	422.00
Stearic acid	3.09	154.50
Butyl Palmitate	0.34	17.00
Arachidic acid methyl ester	0.33	16.50
n-Propyl,11-Octadecenoate	0.34	17.00
1-Hexacosene	0.18	9.00
D-Arabinose, dipropyl mercaptal	0.16	8.00
Androstane 3,17-dione,12-hydroxyl-(5α, 12α)	0.98	49.00
1-Chlorodocosane	0.20	10.00
(Z)-3-(Heptadec-10-en-1-yl) phenol	0.82	41.00
3-([4Z,7Z]-Heptadeca-4,7-diene-1-yl) phenol	0.39	19.50
2,6,10,14,18-Peantamethyl-2,6,10,14,18-eicosapentaene	0.27	13.50

(Iyasele et al., 2022)

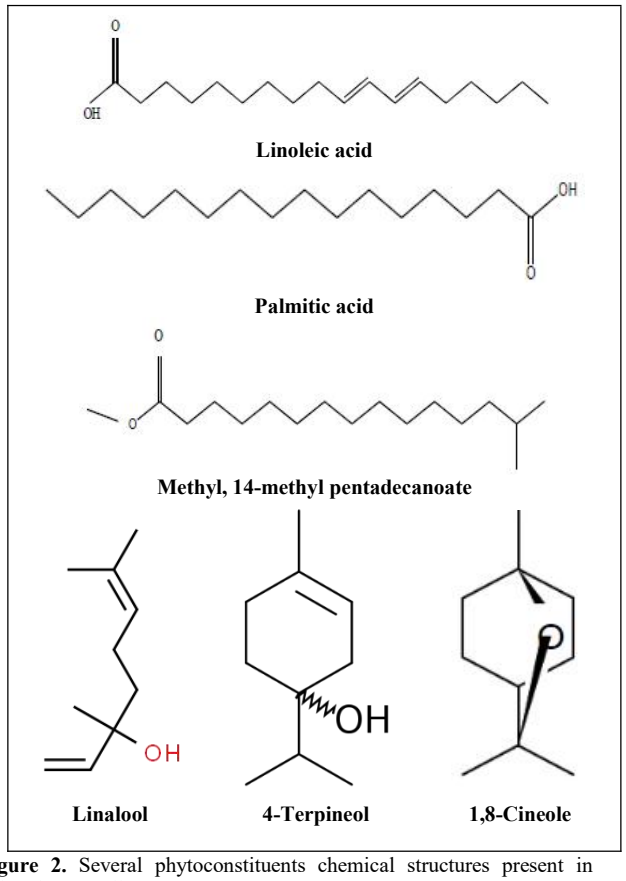

Figure 2. Several phytoconstituents chemical structures present in *Adonidia merrillii*

Table 4. Chemical compounds on *Adonidia merrillii* flower essential oils

Compounds	% composition
1,8-Cineole	12.1
cis-Linalool oxide	2.2
trans-Linalool oxide	3.6
Linalool	43.8
Camphor	2.9
Borneol	6.8
4-Terpineol	13.7
p-Cymen-8-ol	1.3
α-Terpineol	8.5
trans-Ascaridolglycol	2.4
Elemol	2.5

(Nkop et al., 2021)

Anticancer property

A. merrillii fruit pericarp extract shows high phenolic content, especially flavonoids. This polyphenol content functions as an anticancer that is influenced by various factors such as the type of cancer, working dose, and chemical structure (Essien et al., 2017). This anticancer effect is related to its high antioxidant and antioxidant activity. *A. merrillii* fruit pericarp extract showed anti-proliferative solid activity against HeLa (cervical cancer cells), H 460 (lung cancer cells), MCF-7 (breast cancer cells), and PC-3 (prostate cancer cells) (Essien et al., 2017).

Another study by Lee et al. (2014) explained that the crude extract of *A. merrillii* seeds dissolved with different solvents such as ethyl acetate, hexane, and methanol with a specific ratio showed anticancer properties and cytotoxicity against hepatocellular carcinoma cells. Ethyl acetate and hexane:methanol (11:1) treatments induced hepatoma cell apoptosis and decreased colony-forming ability in hepatoma cell lines Huh-7 and HepG2. Procaspase-3 activity was also significantly decreased in response to ethyl acetate extract treatment in HepG2 cells (Lee et al., 2014).

Antibacterial property

Essien et al. (2017) reported a prominent antibacterial activity of methanol extract of *A. merrillii* fruit pericarps against Gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) than Gram-negative bacteria (*Pseudomonas aeruginosa*, *Eschericia coli*, *Proteus mirabilis*, *Salmonella typhi*, and *Shigella dysenteriae*) with inhibition zones ≥ 10 mm. Iyasele et al. (2022) reported the antibacterial activity of n-hexane on *A. merrillii* seed oil extract by agar diffusion method. *Eschericia coli* and *Proteus vulgaris* showed the highest zone of inhibition. However, the ethanol extract from the leaves showed no antibacterial activity on *Bacillus cereus*, *Eschericia coli*, *Serratia marcescens*, and *Staphylococcus epidermidis* (Fierro, 2022) (Table 5).

The different antibacterial test results are due to differences in concentration, compounds contained in the extracts, and types of bacteria. Gram-positive bacteria *(S. aureus*, *B. subtilis*, and *S. epidermidis*) are more sensitive to chemical compounds than Gram-negative bacteria because they do not have an outer membrane (Essien et al., 2017; Breijyeh et al., 2020). The presence of antibacterial compounds from oil extracts, such as fatty acids, can affect antibacterial activity (Iyasele et al., 2022). Some fatty acids in *A. merrillii* oil extract such as alpha-linoleic acid (34.62%), palmitic acid (16.99%), oleic acid (12.67%), and stearic acid (3.09%) are active as antibacterial agents. Alpha-linoleic acid can induce cell death mechanisms by altering peptidoglycan synthesis in the cell wall (Casillas-Vargas et al., 2021). Palmitic acid and stearic acid can reduce AI-2 (Autoinducer-2) from the quorum sensing (QS) mechanism to develop virulence factors and work synchronously (Casillas-Vargas et al., 2021). Oleic acid can disrupt horizontal gene transfer (HGT) by inhibiting the ATPase activity of TrwD, a Type IV secretion traffic ATPase (Casillas-Vargas et al., 2021).

Antidiarrhea property

Flavonoids are one of the secondary metabolite compounds in *A. merrillii* seed extract. The compound is antibacterial against *Staphylococcus aureus* and *Escherichia coli*, which cause diarrhea (Hasanah, 2016). Its inhibitory power against these bacteria increases when combined with lactic acid probiotic bacteria. Their potential was investigated as an antidiarrhea drug of nanoparticles tested on male Wistar rats. The results showed that the nanoparticle preparation could inhibit diarrhea due to its ability to penetrate the intercellular space and bacterial cell wall. The herbal nano-therapy also considerably increased body weight in the Wistar rat

(Mardiyanto et al., 2019). The large percentage of body weight change is due to the two mechanisms of the active substances used, namely palm seed ethanol extract and lactic acid isolate. Palm seed ethanol extract containing antibacterial flavonoids works to form phenol bonds with membrane proteins on the surface of the bacterial cell wall, thus disrupting the structural function of the cell wall and causing the release of material from inside the bacterium. Lactic acid bacteria isolates work as antidiarrheal by triggering normal gastrointestinal flora to metabolize lactic acid bacteria isolates into butyrate compounds that can reduce gut motility and modulate the immune system (Pawar et al., 2008; Essien et al., 2017). The reduced gut motility causes liquid feces to be reabsorbed by the body and reduces the frequency of diarrhea (Mardiyanto et al., 2019).

According to Clemen-Pascual et al. (2021), the young part of the fruit from this plant contains tannins. Tannins, widely expressed in ethanol plant extracts, are secondary metabolites with pharmacological functions due to their astringent action (Clemen-Pascual et al., 2021). Tannins exhibit antibacterial, antidiabetic, anti-inflammatory, antimicrobial, and anti-tumor activities and can inhibit HIV replication (Argal & Pathak, 2006; Chung et al., 2010; Doss & Anand, 2012; Moabe et al., 2013). Other potentials of tannins, such as antidiarrheal, anti-hemorrhoidal, and homeostatic compounds, were also studied (Gomathy et al., 2012).

Antioxidant activity

A. merrillii fruit pericarp extract showed high antioxidant activity and inhibited 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals by 64.89% at a dose of 2.0 mg/ml each compared to standard ascorbic acid (97.26%) (Essien et al., 2017). Antioxidant compound levels are related to phenolic compounds. The higher the phenolic compounds, the higher the antioxidant activity shown by the extract (Essien et al., 2017). Based on Vafaei (2018), methanol extract, ethyl acetate, and water extract from *A. merrillii* fruit has antioxidant content. The methanol extract showed the highest total phenolic and flavonoid content, which was indicated by compounds reported as having antioxidant properties, such as pyrogallol, gallic acid, naringin, and quercetin. Pyrogallol and gallic acid are the main phenolic compounds in *A. merrillii*, with a dry weight value of pyrogalol of 913.11 ± 0.79 and gallic acid of 101.61 ± 0.19 µg/g. Antioxidant activity can also be seen compared to the free radical activity of standard antioxidants such as (butylated hydroxytoluene) BHT and vitamin C. The free radical activity (DPPH) of *A. merrillii* fruit extract was more substantial than that of ethyl acetate and aqueous extracts despite having lower values than standard antioxidants

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Table 5. Summary of antibacterial activity of *Adonidia merrillii* oil extract against Gram-positive and Gram-negative bacteria

Source of Extract	Concentration of Extract	Isolate	Bacteria gram	Inhibition Effect	Reference
Leaf	200 mg/mL	*Bacillus cereus*	Positive	-	(Fierro, 2022)
	200 mg/mL	*Eschericia coli*	Negative	-	(Fierro, 2022)
	200 mg/mL	*Serratia marcescens*	Negative	-	(Fierro, 2022)
	200 mg/mL	*Staphyloccocus epidermidis*	Positive	-	(Fierro, 2022)
Fruit pericarp	400 µg/mL	*Bacillus subtilis*	Positive	+++	(Essien et al., 2017)
	400 µg/mL	*Eschericia coli*	Negative	+++	(Essien et al., 2017)
	950 mg/mL	*Eschericia coli*	Negative	+++	(Iyasele et al., 2022)
	400 µg/mL	*Proteus mirabilis*	Negative	+++	(Essien et al., 2017)
	950 mg/mL	*Proteus vulgaris*	Negative	+++	(Iyasele et al., 2022)
	400 µg/mL	*Pseudomonas aeruginosa*	Negative	++	(Essien et al., 2017)
	950 mg/mL	*Pseudomonas aeruginosa*	Negative	+++	(Iyasele et al., 2022)
	400 µg/mL	*Salmonella typhi*	Negative	++	(Essien et al., 2017)
	400 µg/mL	*Shigella dysenteriae*	Negative	++	(Essien et al., 2017)
	400 µg/mL	*Staphyloccocus aureus*	Positive	+++	(Essien et al., 2017)
	950 mg/mL	*Staphyloccocus aureus*	Positive	+++	(Iyasele et al., 2022)

Note: +++: extract had strong inhibitory effect; ++: extract had medium inhibitory effect; +: extract had weak inhibitory effect; -: absence/no effect

Conclusion

Adonidia merrillii (Becc.) Becc. is a plant that has the potential for human wealth. Ethnobotanical studies show that a whole and every part of this plant is widely used in several countries as an ornamental and medicinal plant. The content of phytochemical compounds has also been widely studied and is known to have potential as anticancer, antibacterial, antidiarrheal, and antioxidant.

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Disclosure of interest

The authors report no conflict of interest.

References

Abe R. & Ohtani K. (2013). An ethnobotanical study of medicinal plants and traditional therapies on Batan Island, the Philippines. Journal of Ethnopharmacology, 145, 554 –565. https://doi.org/10.1016/j.jep.2012.11.029.

Akinmoladun, A. C., Ibukun, E. O., & Dan-Ologe, I. A. (2007). Phytochemical constituents and antioxidant properties of extracts from the leaves of *Chromolaena odorata*. Scientific Research and Essay, 2(6), 191 – 194.

Antia, B. S., Essien, E. E., & Udonkanga, E. D. (2017). Nutritional Composition and Acute Toxicity Potentials of *Archontophoenix tukeri* and *Adonidia merrillii* Kernels. UK Journal of Pharmaceutical and Biosciences, 5(3), 01 – 08. https://doi.org/10.20510/ukjpb/5/i3/155956.

Ao, C., Li, A., Elzaawely, A. A., Xuan, T. D., & Tawata, S. (2008). Evaluation of antioxidant and antibacterial activities of *Ficus microcarpa* L. fil. Extract. *Food Control*, *19*(10), 940 – 948. https://doi.org/10.1016/j.foodcont.2007.09.007.

Argal, A. & Pathak, A. K. (2006). CNS activity of *Calotropis gigantea* roots. Journal of Ethnopharmacology, 106(1), 142 – 145. https://doi.org/10.1016/j.jep.2005.12.024.

Beccari, O. (1909). Notes on Philippine palms, II. Philippine Journal of Science (Botany), 2, 600 – 637.

Boucherit, H., Benaradj, A., Boughalem, M., & Benabdeli, K. (2018). Ethnobotanical study of *Hammada scoparia* (Pomel) Iljin in the region of Naâma (south-western Algeria). Arabian Journal of Medicinal and Aromatic Plants, 4(2), 66 – 75. https://doi.org/10.48347/IMIST.PRSM/ajmap-v4i2.13915.

Breijyeh, Z., Jubeh, B. & Karaman, R. (2020). Resistance of Gram-Negative Bacteria to Current Antibacterial Agents and Approaches to Resolve It. Molecules, 25(6), 1 – 23. https://doi.org/10.3390/molecules25061340.

Casillas-Vargas, G., Ocasio-Malave, C., Medina, S., Morales-Guzman, C., Valle, R. D. D., Carballeira, N. M. & Sanabria-Rios, D. J. (2021). Antibacterial fatty acids: An update of possible mechanisms of action and implications in the development of the next-generation of antibacterial agents. Progress in Lipid Research, 82, 1-10. https://doi.org/10.1016/j.plipres.2021.101093.

Catalogue of Life. (2024). https://www.catalogueoflife.org/data/taxon/654K8. *Adonidia merrillii* (Becc.) Becc. Accessed: 27 February 2024.

Chung, K. T., Wong, T. Y., Wei, C. I., Huang, Y. W., & Lin, Y. (2010). Tannins and Human Health: A Review. Critical Reviews in Food Science and Nutrition, 38(6), 421 – 464. https://doi.org/10.1080/10408699891274273.

Clemen-Pascual, L. M., Macahig, R. A. S., & Rojas, N. R. L. (2021). Comparative Toxicity, Phytochemistry, and Use of 53 Philippine Medicinal Plants. Toxicology Reports, 9, 22-35. https://doi.org/10.1016/j.toxrep.2021.12.002.

Darmadi, A.A.K. (2014). Etnobotani : Ragam Etnobotani di Bali. Denpasar: Udayana University Press.

Doss, A. & Anand, S. P. (2012). Preliminary Phytochemical Screening of *Asteracantha longifolia* and *Pergularia daemia*. World Applied Sciences Journal, 18(2), 233 – 235. https://doi.org/10.5829/idosi.wasj.2012.18.02.1136.

Essien, E. E., Antia, B. S., Solomon, A. U., & Choudhary, M. I. (2017). In vitro Cytotoxic, Antioxidant and Antimicrobial Activities of *Adoninia merrillii* and *Archontopheonix tukeri* Fruit Pericarps. UK Journal of Pharmaceutical Biosciences, 5(1), 68 – 75. https://doi.org/10.20510/ukjpb/5/i1/147028.

Fernando, E. S. (2011). *Adonidia merrillii* - a new wild population in the Philippines. Palms, 55(2), 57 – 61.

Fierro, E. M. D. (2022). Phytochemical Properties and Antimicrobial Activities of Some Medicinal Plants in Cebu, Philippines. AMJ, 62(1), 775 – 782.

Gomathy, G., Vijay, T., Sarumathy, K., Gunasekaran, S., & Palani, S. (2012). Phytochemical screening and GC-MS analysis of *Mukia maderaspatana* (L.) leaves. Journal of Applied Pharmaceutical Science, 2(12), 104 – 106. https://doi.org/10.7324/JAPS.2012.21220.

Gu, R., Wang, Y., Long, B., Kennelly, E., Wu, S., Liu, B., Li, P., & Long, C. (2014). Prospecting for bioactive constituents from traditional medicinal plants through ethnobotanical approaches. Biological and Pharmaceutical Bulletin, 37(6), 903 – 915. https://doi.org/10.1248/bpb.b14-00084.

Gutierrez, R. L. V. (2023). Nutritional, Phytochemical Contents and Cytotoxicity of Bua China, *Adonidia merrillii* Fruits. International Journal of Chemistry & Material Sciences, *8*(1), 1 – 19.

Hasanah, R. A. (2016). Standarisasi dan uji aktivitas antibaktei ekstrak biji palem putri (*Adonidia merrillii* (Becc.) Becc.) terhadap *Staphylococcus aureus* dan *Escherichia coli*'. Department of Pharmacy Faculty of Science Sriwijaya University [Undergraduate Thesis]. Palembang: Sriwijaya University.

Heim, L. (2015). Flora and Vegetation of Bali Indonesia : An Illustrated Field Guide. Norderstedt: Herstellung und Verlag.

Hidayat, N. N. R., Anggreini, P., & Indriyanti, N. (2022). Studi Etnofarmasi Tanaman Berkhasiat Obat pada Suku Paser di Desa Samurangau dan Desa Tepian Batang Kabupaten Paser. Proceeding of Mulawarman Pharmaceuticals Conferences 2022, 40 – 48. https://doi.org/10.25026/mpc.v16i1.671.

Hussin, N. S. M., Ismail, A. R., Hasbullah, S. W., & Kadir, N. A. (2020). Properties Of Textiles Dyed with Young *Adonidia merrillii* (Betel Nut) Fruit Husk. International Journal of Scientific & Technology Research, 9(3), 1817 – 1822.

Iyasele, J. U., Uadia, J. O., Akhigbe, I. U., Jacob, J. N., & Ogbeide, O. K. (2022). Physico-Chemical Properties, Chemical Composition and Antimicrobial Activity of *Adonidia merrilli* Kernel Seed Oil. Trop J Nat Prod Res, 6(4), 599 – 605. https://doi.org/10.26538/tjnpr/v6i4.22.

Jayakumar, S., Sathiskumar, S., Baskaran, N., Arumugam, R., & Vanitha, V. (2017). Ethno-veterinary practices in Southern India for captive Asian elephant ailments. Journal of Ethnopharmacology, 200, 182 - 204. https://doi.org/10.1016/j.jep.2017.02.039.

Lee, K. H., Tang, H. P., Tyan, S. W., Liu, K. H., Hung, J. H. (2014). Induction of cytotoxicity by Manila Palm Seed Extracts in Hepatocellular Carcinoma Cells. Chia-Nan Annual Bulletin, 40, 1 – 8.

Lim, T. K. (2012). Edible Medicinal and Non-Medicinal Plants. Dordrecht: Springer.

Madani, S., Amel, B., Noui, H., Djamel, S., & Abderrahim, B. (2015). Flora and ethnobotany of medicinal plants in the southeast of the capital of Hodna (Algeria). Arabian Journal of Medicinal & Aromatic Plants, 1(1), 24 – 30. https://doi.org/10.48347/IMIST.PRSM/ajmap-v1i1.3255.

Manoharan, S. & Kaur, J. (2013). Anticancer, Antiviral, Antidiabetic, Antifungal and Phytochemical Constituents of Medicinal Plants. American Journal of Pharmtech Research, 3(4), 149 – 169. https://doi.org/10.1155/2022/9544915.

Maobe, M. A. G., Gatebe, E., Gitu, L., & Rotich, H. (2013). Preliminary Phytochemical Screening of Eight Selected Medicinal Herbs Used for the Treatment of Diabetes, Malaria and Pneumonia in Kisii Region, Southwest Kenya. European Journal of Applied Sciences, 5(1), 01 – 06. https://doi.org/10.5829/idosi.ejas.2013.5.1.65127.

Mardiyanto, Sandi, S., Herlina, & Kurniawan, I. (2019). Nanoparticulate formulation of christmas palm seed (*Adonidia merrillii*) ethanolic extract containing lactic acid for antidiarrheal therapy. Journal of Physics: Conference Series, 1282, 012084. https://doi.org/10.1088/1742-6596/1282/1/012084.

Martinez, J. L., Muñoz-Acevedo, A., & Rai, M. (2019). Ethnobotany : Application of Medicinal Plants. Boca Raton: CRC Press.

McCurrach, J.C. (1960). Palms of the World. New York: Harper & Brothers.

Meddour, R. & Meddour-Sahar, O. (2015). Medicinal plants and their traditional uses in Kabylia (Tizi Ouzou, Algeria). Arabian Journal of Medicinal & Aromatic Plants, 1(2), 137 – 151. https://doi.org/10.48347/IMIST.PRSM/ajmap-v1i2.4331.

Merrill, E.D. (1922). An Enumeration of Philippine Flowering Plants, vol. 1. Manila: Bureau of Printing.

Moabe, M.A.G., Gatebe, E., Gitu, L., & Rotich, H. (2013). Preliminary phytochemical screening of eight selected medicinal herbs used for the treatment of diabetes, malaria, and pneumonia in Kisii Region, Southwest Kenya. European Journal of Applied Sciences, 5 (1), 01-06.

Mutaqin, A. Z., Maspudin, K., & Husodo, T. (2016). Pemanfaatan Hasil Hutan Bukan Kayu oleh Masyarakat Desa Pangandaran Kecamatan Pangandaran Kabupaten Pangandaran. Prosiding Seminar Nasional Pendidikan Biologi dan Biologi FMIPA UNY, B-103 – B-114.

National Parks Flora and Fauna Web. (2023). https://www.nparks.gov.sg/florafaunaweb/flora/2/6/2688. *Adonidia merrillii* (Becc.) Becc. Accessed: 30 January 2023.

Nkop, E. J., Essien, E. E., Thomas, P. S., & Flamini, G. (2021). Chemical Composition of *Dillenia indica* Fruit and *Adonidia merrillii* Floral Volatile Metabolites. Chemistry of Natural Compounds, 57(1), 177 – 179. https://doi.org/10.1007/s10600-021-03312-2.

Oderinlo, O. O., Adenekan, O. A., Alawode, T. T., Osamudiamen, P. M., Oluremi, B. B., Oyeneyin, O. E., Ngoepe, M. P. (2021). Ethnobotanical Appraisal and *In-silico* Investigation of Plants Used for the Management of COVID-19 in Southwestern Nigeria. Arabian Journal of Medicinal & Aromatic Plants, 7(1), 151 – 174. https://doi.org/10.48347/IMIST.PRSM/ajmap-v7i1.23748.

Ouhaddou, H., Alaoui, A., Laaribya, S., & Ayan, S. (2020). Ethnobotanical survey of medicinal plants used for treating diabetes in Agadir Ida Outanane region, Southwestern Morocco. Arabian Journal of Medicinal & Aromatic Plants, 6(2), 72 – 86. https://doi.org/10.48347/IMIST.PRSM/ajmap-v6i2.22375.

Ozturk, M. & Hakeem, K.R. (2018). Plant and Human Health, Volume 1 : Ethnobotany and Physiology. Cham: Springer.

Paramita, S., Kosala, K., Dzulkifli, D., Saputri, D. I., & Wijayanti, E. (2017). Anti-inflammatory activities of ethnomedicinal plants from Dayak Abai in North Kalimantan, Indonesia. Biodiversitas : Journal of Biological Diversity, 18(4), 1556 – 1561. https://doi.org/10.13057/biodiv/d180433.

Pawar, A. P., Gadhe, A. R., Venkatachalam, P., Sher, P., & Mahadik, K. R. (2008). Effect of core and surface cross-linking on the entrapment of metronidazolein pectin beads. Acta Pharmaceutica, 58(1), 75 – 85. https://doi.org/10.2478/v10007-007-0046-0.

Putri, E. K. & Bashri, A. (2019). Ethnobotanical Study of Plant in Historical-Religious Tourism Area and the Sacred Place at Sumenep, Madura. Biotropika: Journal of Tropical Biology, 7(3), 102 – 111. https://doi.org/10.21776/ub.biotropika.2019.007.03.3.

Singh, Y. D., Panda, M. K., & Satapathy, K. B. (2020). Ethnomedicine for Drug Discovery. In Patra, J. K., Shukla, A. C., Das, G. (eds.) Advances in Pharmaceutical Biotechnology : Recent Progress and Future Applications. Springer, Singapore. pp. 15 – 28.

Sulistia, E., Sukenti, K., & Mulyaningsih, T. (2021). Kajian Etnobotani Arecaceae Pada Masyarakat Kabupaten Lombok Barat. Seminar Nasional Perhimpunan Masyarakat Etnobiologi Indonesia. 56 – 62.

Teshome, M., Kebede, F., & Yohannes, T. (2023). An Ethnobotanical Survey of Indigenous Knowledge on Medicinal Plants Used by Communities to Treat Various Diseases around Ensaro District, North Shewa Zone of Amhara Regional State, Ethiopia. Scientifica, 2023, 5575405. https://doi.org/10.1155/2023/5575405.

Vafaei, A. (2013). Antioxidant and Cytotoxicity Activities of *Veitchia merrillii* Fruits. Institute of Biological Sciences Faculty of Science University of Malaya Kuala Lumpur [Thesis]. Kuala Lumpur: Malaya Kuala Lumpur University.

Vafaei, A., Mohamad, J. B., & Karimi, E. (2018). HPLC profiling of phenolics and flavonoids of *Adonidia merrillii* fruits and their antioxidant and cytotoxic properties. Natural Product Research, 33(17), 2531 – 2535. https://doi.org/10.1080/14786419.2018.1448810.

Young, K.J. (2007). The Green World Ethnobotany. New York: Chelsea House.

Zona, S. & Fuller, D. (1999). A Revision of Veitchia (Arecaceae—Arecoideae). Harvard Papers in Botany, 4 (2), 543 – 560.