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Araceae Floristic and Potential Study in Bogor Botanical Gardens, West Java, Indonesia

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ABSTRACT

Bogor Botanical Gardens is a conservation area that assists the preservation of flora in Indonesia, including the Araceae. Araceae is often used by the public as medicine, food sources, and ornamental plants. Therefore, the Araceae is often used as an interesting research object and conservation efforts have commenced maintaining its sustainability. The purpose of this research was to determine the species of living Araceae and the potential possessed by each living Araceae species in the conservation area of the Bogor Botanical Gardens. This research was conducted on 8-9 June 2021 to determine the diversity and potential of the Araceae in Bogor Botanical Gardens. The method used in this research is the exploring method and data analysis using descriptive method. The result of this research revealed there were 60 species of Araceae consisting of 25 genera. The genera with the highest number of species are Philodendron. Two species of them are Araceae which has a habitat in the waters. A total of 33 species are terrestrial and 25 are epiphytic plants. Araceae have many potentials, such as food, aromatic, medicine, flavoring, animal feed, and ornamental plants. More than 50% of the Araceae species were used as ornamental plants.

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INTRODUCTION

Indonesia is a country that has a high level of flora and fauna diversity. This high biodiversity is partly due to the geographical location of Indonesia, which is traversed by the equator and is located in a tropical climate. Of the approximately 1.7 million species of plants that exist in the world, around 101,000 species have been identified in Indonesia and 40-50% are endemic plants (LIPI, 2014; BAPPENAS, 2016; Aryani, 2016). This diversity includes various kinds of plants, one of which is the Araceae.

Araceae is one of the largest monocotyledonous families with key characteristics, namely herbs and inflorescences arranged in the form of a cob (spadix) surrounded by a spathe (Boyce et al., 2010). This family can grow well in tropical areas that have high humidity and will be difficult to grow in dry conditions (Kurniawan et al., 2013). According to Suhono et al. (2010), Araceae plants can live in lowland and highland areas with moderate to cold climates, so Araceae plants are often found in Indonesian forest areas.

The Araceae has become one of the most important plants in Indonesia. This is because many

species of Araceae have their potential, so Araceae plants are widely used to meet the needs of the Indonesian people, such as food, medicine, ornamental, and others. Generally, the species of Araceae genera *Aglaonema* and *Anthurium* have the potential as ornamental plants. Several species of Araceae also have potential as alternative food ingredients, such as taro (*Colocasia esculenta* (L.) Schott) and suweg (*Amorphophallus paeoniifolius* (Dennst.) Nicolson); as medicine, namely rat taro (*Typhonium flagelliform* Blume) and *Epipremnum pinnatum* (L.) Engl.; as well as animal feed ingredients such as *Montrichardia arborescens* (L.) Schott. The high potential and diversity of Araceae in Indonesia encourage experts to conduct research on Araceae in various regions in Indonesia.

One area that has the potential for habitat for Araceae growth is the Bogor Botanical Gardens. Bogor Botanical Gardens is an ex-situ plant conservation area in Indonesia. The existence of Araceae species in the Bogor Botanical Gardens has been previously reported by several researchers. Yuzammi (2018) reported that there were 36 genera and 130 species with 21 genera native to Indonesia, Bogor Botanical Gardens. Hariri et al. (2019) report that two species of *Typhonium* grow and spread in the Bogor Botanical Gardens. In this study, data were collected on all live Araceae species found in the collection and non-collection areas that we explored. This study aims to determine the species of living Araceae and the potential possessed by each living Araceae species in the conservation area of the Bogor Botanical Gardens.

MATERIALS AND METHODS

The research was conducted at the Bogor Botanical Gardens, Central Bogor District, Bogor City, West Java. This research was conducted during June 8-9, 2021. This study was a descriptive method using exploring method of data collection. Determination of the location is done by purposive sampling. The tools used in this research are meter, stationery, GPS (Global Positioning System), identification book "The Genera of Araceae" and camera. The materials or objects in this study are plant species of the Araceae.

The research location was determined by exploring the Bogor Botanical Gardens area which was divided into 7 locations (Figure 1). The Araceae plants found were observed by recording their characters in detail and documenting. Identification of Araceae was carried out using the identification literatures: The Genera of Araceae (Mayo et al., 1997), Descriptor Taro (IPGRI, 1999), and The Araceae of Borneo–The Genera (Boyce et al., 2010). In addition, a literature study was also conducted on several potentials possessed by each type of Araceae that live in the Bogor Botanical Gardens area. Data on Araceae species are presented qualitatively in the form of a description of the character, habitat, and distribution of Araceae plants accompanied by photos of dominant species. Furthermore, the use of Araceae plants found in the conservation area of the Bogor Botanical Gardens is presented.

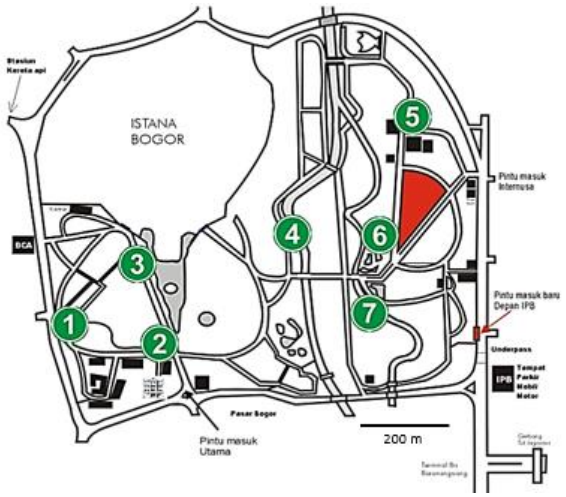

Figure 1. Map of Research Locations. (1) Araceae garden, (2) Araceae collection garden, (3) Kenari I street, (4) Kenari II street, (5) Orchid nursery, (6) Giant lotus pond, (7) Astrid Avenue.

RESULTS AND DISCUSSION

Based on observations that have been made, obtained 60 species from 25 genera Araceae in the Bogor Botanical Gardens (Table 1). Location 2 has the most abundant Araceae species diversity because this location was a collection location for Araceae. The most commonly found genus of Araceae is *Philodendron*. The Araceae were observed to grow in three species of habitats, namely terrestrial as many as 33 species, epiphyte as many as 25 species, and aquatic as many as 2 species.

Locations 1 and 2 had the highest number of collection plant species, while at location 7 there were only non-collected plants. Furthermore, the distribution of collected and non-collected plant species in the Bogor Botanical Gardens based on each location can be seen in Figure 2.

Collection plants are plants that have recorded species names, important information, the process of entering the Botanical Gardens until the plants die.

Table 1. Distribution of Araceae species in Bogor Botanical Gardens and their habitats.

Genus	Species	Habitat	Location						
			1	2	3	4	5	6	7
Aglaonema	*A. marantifolium* Blume	Terrestrial		●					
	A. nitidum (Jack) Kunth			●					
	A. simplex Blume			●					
Alocasia	*A. alba* Schott	Terrestrial	●	●	○				
	A. macrorrhizos (L.) G.Don		●	●			●		○
	A. suhirmaniana Yuzammi & A.Hay						●		
Amorphophallus	*A. muelleri* Blume	Terrestrial		●					
	A. paeoniifolius (Dennst.) Nicolson			●					
	A. titanum (Becc.) Becc.		●						
	Amorphophallus sp.			◐			○		
Amydrium	*A. zippelianum* (Schott) Nicolson	Epiphyte				●			
	Amydrium sp.			●					
Anthurium	*A. cordatum* (L.) Schott	Terrestrial		●					
	A. crassinervium (Jacq.) Schott						●		
	A. pedatoradiatum Schott			●					
	Anthurium sp.			●			●		
Apoballis	*A. acuminatissima* (Schott) S.Y.Wong & P.C.Boyce	Terrestrial		●					
	A. rupestris (Zoll. & Moritzi) S.Y.Wong & P.C.Boyce			●					
Colocasia	*C. esculenta* (L.) Schott	Terrestrial	◐	○	○	○	○	○	○
Culcasia	*C. mannii* (Hook.f.) Engl.	Terrestrial		●					
Cyrtosperma	*Cyrtosperma* sp.	Aquatic						●	
Dieffenbachia	*D. bowmannii* H.J.Veitch	Terrestrial		●					
	D. fournieri N.E.Br.			●					
	D. seguine (Jacq.) Schott		●	●					
	D. x splendens W.Bull			●		○			
	Dieffenbachia sp.					○	◐		○
Epipremnum	*E. falcifolium* Engl.	Epiphyte		●		●			
	E. nobile (Schott) Engl.		●	●					
	E. pinnatum (L.) Engl.		●	◐		○	○		○
Homalomena	*H. cordata* Schott	Terrestrial		●	○				
	H. pendula (Blume) Bakh.f.		◐	●			●		
Leucocasia	*L. gigantea* (Blume) Schott	Terrestrial	●			○	○	○	○
Monstera	*M. oblique* Miq.	Epiphyte		●					
Montrichardia	*M. arborescens* (L.) Schott	Aquatic						●	
Philodendron	*P. bipinnatifidum* (Schott ex Endl.) Sakur.	Epiphyte	●			●			
	P. crassinervium Lindl.					○			
	P. erubescens K.Koch & Augustin				○	◐			
	P. imbe Schott ex Kunth		●						
	P. melanochrysum Linden & André				◐		○		
	P. panduriforme (Kunth) Kunth		○		●				
	P. sagittifolium Liebm.				●				
	P. squamiferum Poepp.					●			
	P. tripartitum (Jacq.) Schott					●			
	Philodendron sp.		○		●	●			
Pothos	*Pothos* sp.	Epiphyte		●					
Rhaphidophora	*R. foraminifera* (Engl.) Engl.	Epiphyte	○		○	◐	○		
	R. korthalsii Schott					●			
	R. montana (Blume) Schott					●			
	R. sylvestris (Blume) Engl.					●			
Rhodospata	*Rhodospata* sp.	Epiphyte	●						
Schismatoglottis	*S. calyptrata* (Roxb.) Zoll. & Moritzi	Terrestrial	●	◑					
Scindapsus	*S. pictus* Hassk.	Epiphyte		○					
Spathiphyllum	*S. cannifolium (Dryand. ex Sims) Schott*	Terrestrial	●	●					

Genus	Species	Habitat	Location						
			1	2	3	4	5	6	7
	S. commutatum Schott			●	●				
	Spathiphyllum sp.		●		●			●	
Syngonium	*S. auritum* (L.) Schott	Epiphyte			●	○			
	S. podophyllum Schott		●	●	●	○			○
Xanthosoma	*X. robustum* Schott	Terrestrial		●					
	X. sagittifolium (L.) Schott			●					
Zamioculcas	*Z. zamiifolia* (G.Lodd.) Engl.	Terrestrial		●					

Note: ●: collectible plant, ○: non-collected plant,◐ : collectible and non-collected plant

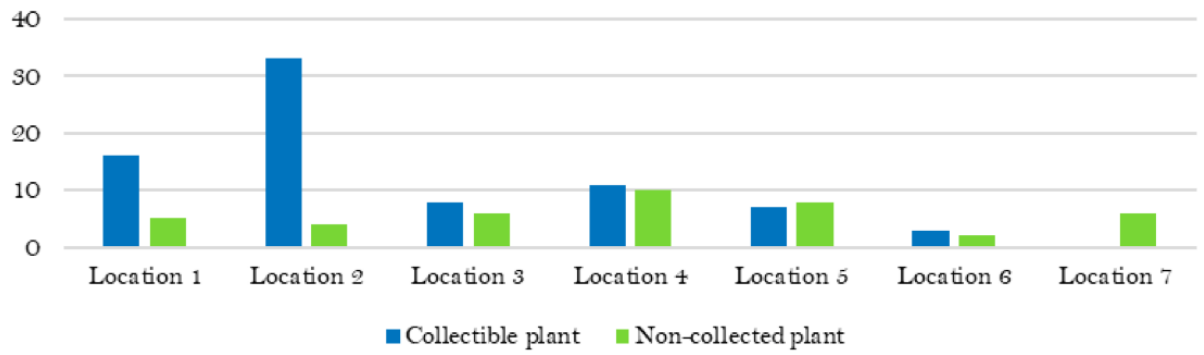

Figure 2. Number of collection and non-collection plant species in the Bogor Botanical Gardens

Usually, collection plants have a registration number to make it easier for the Botanical Gardens to manage the collection. Meanwhile, non-collected plants are plants that live in the Botanical Gardens area but do not have a registration number like collection plants. In addition, non-collected plants usually grow in poorly managed areas. Figure 1 shows the number of collected plant species is greater than that of non-collected plants. This is influenced by the role of the Botanical Gardens themselves, according to Presidential Decree No. 93 of 2011 is an ex-situ plant conservation area that has a documented and organized plant collection based on a taxonomic, bioregional, thematic classification pattern or a combination of these patterns for conservation, research, education, tourism, and environmental services. Of course, there will be more collection plants than non-collections. Non-collected plants also live in the Bogor Botanical Gardens area, especially in areas that are not managed by the Botanical Gardens. Non-collected Araceae can grow wild because the seeds disperse outside the Araceae collection gardens. Barrancos et al. (2019) and Renner (2004) reported Araceae could disperse via wind, water current, and animals, such as a bird. Furthermore, Araceae grow in a wide range of environments, so they are easy to find anywhere (Croat, 2019).

Locations 1 and 2 have the highest number of collection plant species because these locations are Araceae collection gardens. Likewise, location 7 only has non-collected Araceae plants because location 7 is a quite lush and only has a path that is covered by other plants. The results of environmental observation show that soil humidity in 7 locations was 40-90%. Harahap (2020) and Mansur (2021) reported Araceae can grow in 15-90% humidity. Soil temperature on 7 locations was 27-33^{o}C and water temperature on location 6 was 32^{o}C. Ivanvic et al. (2008) and Zotz et al. (2019) reported Araceae was able to grow in 20-40^{o}C temperature. Soil acidity levels (pH) on 7 locations were 7-8 and water pH was 5. Sumarwoto (2004) reported Araceae can grow on 5.6-7.5 in pH. Based on these results, all the locations are good habitats for the growth of Araceae. The differences in the number of Araceae in each location could be due to competition between plants, especially in the poorly managed area. Competition with other plants, especially Poaceae, will harm Araceae because Poaceae has great competitiveness and is one of the aggressive pioneer species (Susanti et al., 2013).

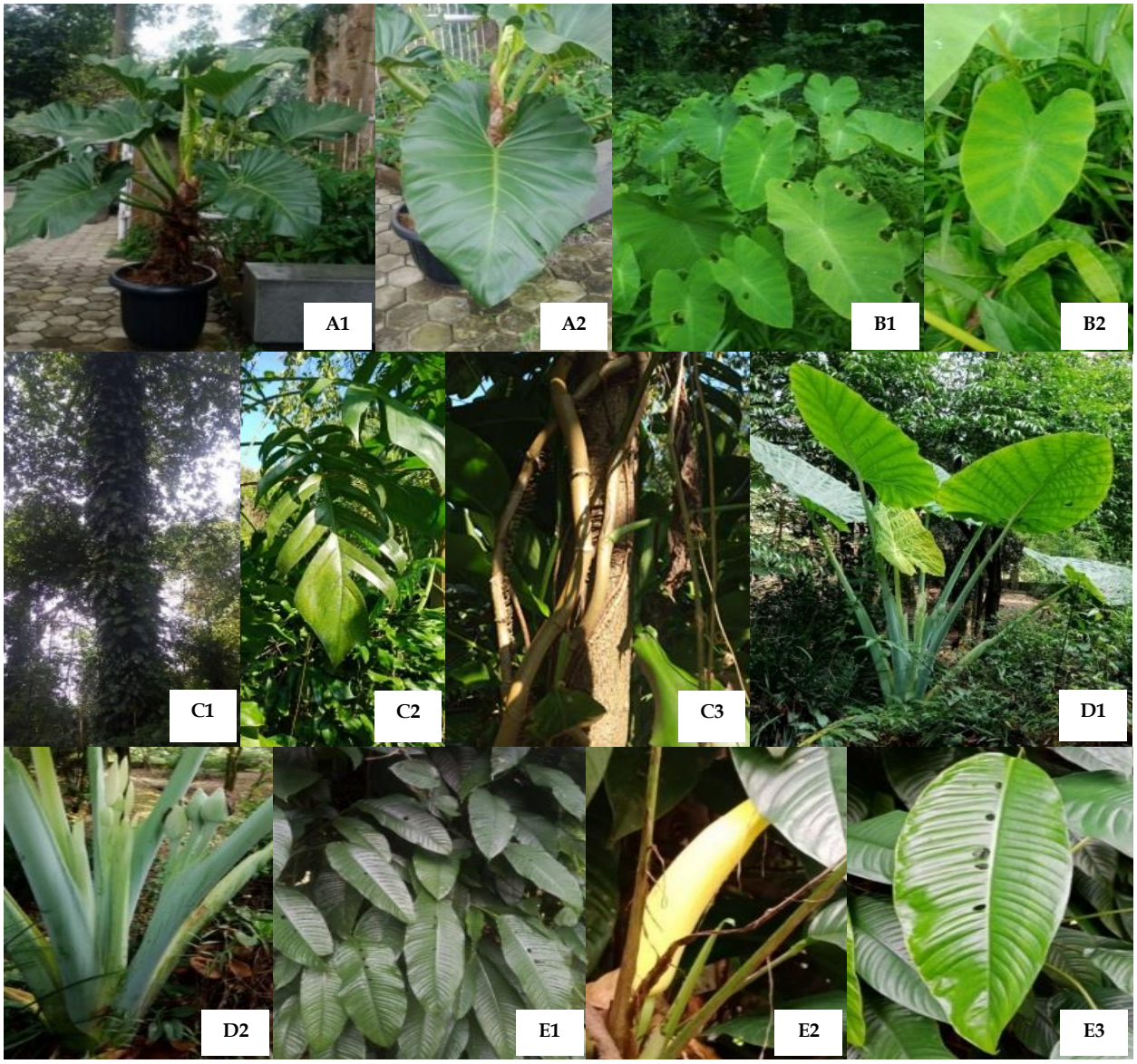

Figure 3
. A. *Alocasia macrorrhizos* (L.) G.Don (1), adaxial leaf (2); B. *Colocasia esculenta* (L.) Schott (1), adaxial leaf (2); C. *Epipremnum pinnatum* (L.) Engl.: creeping on the tree (1), adaxial leaf (2), stem (3); D. *Leucocasia gigantea* (Blume) Schott (1), inflorescence (2); and E. *Rhaphidophora foraminifera* (Engl.) Engl. (1), inflorescence (2), young leaves that have perforations (3).

Table 3. Potential species of Araceae that grow and are cultivated in the Bogor Botanical Gardens as plants, food, ornamental, medicines, aromatics, and others

Genus	Species	Usefulness					References
		Food	Ornamental	Medicines	Aromatics	Others	
Aglaonema	*A. marantifolium* Blume		●				Nicolson, 1969
	A. nitidum (Jack) Kunth		●				Ilhamullah et al., 2015
	A. simplex Blume		●	●			Ilhamullah et al., 2015; Ismail et al., 2017

Genus	Species	Usefulness					References
		Food	Ornamental	Medicines	Aromatics	Others	
Alocasia	*A. alba* Schott		●				Asih and Kurniawan, 2019
	A. macrorrhizos (L.) G.Don	●	●	●			Koller, 2008; Erlinawati, 2010; Yuzammi, 2018; El-Deen et al., 2008
	A. suhirmaniana Yuzammi & A.Hay		●				Erlinawati, 2010
Amorphophallus	*A. muelleri* Blume	●		●			Asih and Kurniawan, 2019; Wahidah et al., 2021
	A. paeoniifolius (Dennst.) Nicolson	●		●		animal feed	Erlinawati, 2010; Mutaqin et al., 2018
	A. titanum (Becc.) Becc.		●				Yudaputra et al., 2021
	Amorphophallus sp.	●		●			Asih and Kurniawan, 2019; Mutaqin et al., 2018; Wang and Li, 2021
Amydrium	*A. zippelianum* (Schott) Nicolson		●				Lemmens et al., 1995
	Amydrium sp.		●				Lemmens et al., 1995
Anthurium	*A. cordatum* (L.) Schott		●				Yuzammi, 2018
	A. crassinervium (Jacq.) Schott		●				Yuzammi, 2018
	A. pedatoradiatum Schott		●				Yuzammi, 2018
	Anthurium sp.		●	●			Vardhana, 2008; Yuzammi, 2018
Apoballis	*A. acuminatissima* (Schott) S.Y.Wong & P.C.Boyce		●				Yuzammi, 2018
	A. rupestris (Zoll. & Moritzi) S.Y.Wong & P.C.Boyce		●				Widodo and Wibowo, 2012
Colocasia	*C. esculenta* (L.) Schott	●		●		animal feed	Asih and Kurniawan, 2019; Erlinawati, 2010; Murthy, 2021
Culcasia	*C. mannii* (Hook.f.) Engl.		●				Yuzammi, 2018
Cyrtosperma	*Cyrtosperma* sp.		●				Yuzammi, 2018
Dieffenbachia	*D. bowmannii* H.J.Veitch		●	●			Syamjith et al., 2018
	D. fournieri N.E.Br.		●				Yuzammi, 2018
	D. seguine (Jacq.) Schott		●				Mutaqin et al., 2018
	D. x splendens W.Bull		●				Yuzammi, 2018
	Dieffenbachia sp.		●	●			Oloyede et al., 2012
Epipremnum	*E. falcifolium* Engl.		●				Yuzammi, 2018
	E. nobile (Schott) Engl.		●				Yuzammi, 2018
	E. pinnatum (L.) Engl.		●	●			Asih and Kurniawan, 2019; Yuzammi, 2008
Homalomena	*H. cordata* Schott				●		Yuzammi, 2018
	H. pendula (Blume) Bakh.f.		●	●	●		Yuzammi, 2018
Leucocasia	*L. gigantea* (Blume) Schott	●				flavoring	Sin Yeng, 2016; Sulaiman and Mansoor, 2002
Monstera	*M. oblique* Miq.		●				Yuzammi, 2018
Montrichardia	*M. arborescens* (L.)	●	●	●		Food for	Andel TR, 2000; Portal et

Genus	Species	Usefulness					References
		Food	Ornamental	Medicines	Aromatics	Others	
	Schott					manatee and turtle	al., 2002
Philodendron	*P. bipinnatifidum* (Schott ex Endl.) Sakur.		●	●			Kujawska et al., 2017
	P. crassinervium Lindl.		●				Yuzammi, 2018
	P. erubescens K.Koch & Augustin		●				Rameshkumar, 2018
	P. imbe Schott ex Kunth		●	●			Yuzammi, 2018
	P. melanochrysum Linden & André		●				Yuzammi, 2018
	P. panduriforme (Kunth) Kunth		●				Yuzammi, 2018
	P. sagittifolium Liebm.		●				Yuzammi, 2018
	P. squamiferum Poepp.		●	●			Otero et al., 2020; Yuzammi, 2018
	P. tripartitum (Jacq.) Schott		●				Yuzammi, 2018
	Philodendron sp.	●	●	●			Kujawska et al., 2017; Rameshkumar, 2018; Yuzammi, 2018
Pothos	*Pothos* sp.		●				Yuzammi, 2018
Rhaphidophora	*R. foraminifera* (Engl.) Engl.		●				Yuzammi, 2018
	R. korthalsii Schott			●			Yeap et al., 2012
	R. montana (Blume) Schott		●				Yuzammi, 2018
	R. sylvestris (Blume) Engl.		●				Yuzammi, 2018
Rhodospata	*Rhodospata* sp.		●				Yuzammi, 2018
Schismatoglottis	*S. calyptrata* (Roxb.) Zoll. & Moritzi	●		●			Erlinawati et al., 2019; Sulaiman and Mansoor, 2002
Scindapsus	*S. pictus* Hassk.		●				Munawaroh and Yuzammi, 2016
Spathiphyllum	*S. cannifolium* (Dryand. ex Sims) Schott		●	●			Abdullah et al., 2012
	S. commutatum Schott						Mutaqin et al., 2018
	Spathiphyllum sp.		●	●			Abdullah et al., 2012
Syngonium	*S. auritum* (L.) Schott		●				Yuzammi, 2018
	S. podophyllum Schott		●				Benedetto et al., 2006
Xanthosoma	*X. robustum* Schott	●		●			Nzietchueng, 1988; Yuzammi, 2018
	X. sagittifolium (L.) Schott	●		●			Caxito et al., 2015; Erlinawati, 2010
Zamioculcas	*Z. zamiifolia*		●	●			Muharini et al., 2018

Research on Araceae diversity in the Bogor Botanical Gardens has been carried out by Yuzammi (2018). In this study, obtained a total of 130 species with 36 genera, while in this study obtained 60 species with 25 genera Araceae. There is a considerable difference in the results between the results of this study and that of Yuzammi (2018). This is because in Yuzammi's research

(2018), data were collected on living Araceae plants and Araceae herbarium, while in this study data was collected only on living Araceae plants. This difference in results can also be caused by the different Araceae growing in 2018 and 2021. We did not find *Aglaodorum*, *Anadendrum*, *Anchomanes*, *Anubias*, *Cercestis*, *Dracontium*, *Gonatopus*, *Holochlamys*, *Lasia*, and *Pistia*. The reason for this difference is that Araceae plants are not well cared for, unable to compete with other epiphytic plants, and the research time is short.

The Araceae has various potentials that can be utilized, such as food, medicine, and ornamental plants. Several species of Araceae which are used as food ingredients are *Colocasia esculenta* (taro) (Figure 3), *Xanthosoma sagittifolium* (keladi), and *Amorphophallus paeoniifolius* (suweg). Araceae plants are also known to be antimalarial, cytotoxic (Frausin et al., 2015), antibacterial, antifungal, anti-inflammatory, and anti-cancer (Chen et al., 2007). Koller (2008) stated that both the rhizome and the leaf of *Alocasia macrorrhizos* can be used to treat cancer, tumors and snake bites. *Dieffenbachia*, which inhibits the activity of *Salmonella typhi* and *Pseudomonas aeruginos*a, and *Colocasia esculenta*, which inhibits the activity of *Vibrio cholerae* and *V. harveyi*. In addition, Araceae can also be used as ornamental plants such as *Alocasia suhirmaniana* and *Anthurium* sp. The potential for Araceae species found in the Bogor Botanical Gardens area is listed in Table 3.

CONCLUSION

Observation results obtained 60 species of Araceae from 25 genera that can be identified in the Bogor Botanical Gardens. Two species of them are Araceae which has a habitat in the waters. A total of 33 species are terrestrial and 25 are epiphytic plants. The location with the most Araceae species found was at location 2 where 34 species of Araceae were found, while location 6 was the location with the least number of Araceae species, which only found 4 species of Araceae. Various potential uses of the Araceae were observed, including food, aromatics, medicine, flavoring, animal feed, and ornamental plants. The greatest potential utilization is as an ornamental plant with a total of 48 species of all species observed.

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