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Macroscopic and Microscopic Analysis of Dollar Plant Leaves (*Zamioculcas zamiifolia* (Lodd.))

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Abstract: The dollar plant (*Zamioculcas zamiifolia* (Lodd.)) shows significant potential for medicinal applications. Despite numerous studies examining the chemical components in dollar plant leaves, there is still insufficient research on their macroscopic and microscopic features. This research was carried out to recognize and detail the macroscopic and microscopic characteristics of the dollar plant leaves and their powder simplisia. This qualitative descriptive study included processes like identifying plants, preparing simplisia, and conducting both macroscopic and microscopic observations. The macroscopic examination emphasized the observation of the leaf's shape, dimensions, and hue, while the microscopic examination sought to recognize anatomical characteristics such as stomata, trichomes, vascular bundles, and calcium oxalate crystals. The research showed that the dollar plant's leaves are a dark green color, glossy, smooth, elongated, featuring flat edges, pointed ends, and rulvunded bases. Under the microscope, the leaves displayed paracytic stomata type, spiral transport bundles, unicellular trichomes, and needle- shaped calcium oxalate crystals. Additional studies on the characterization of other componentsof the dollar plants including stem and roots, for a more complete characterization.

Keywords: Characterization; Dollar plant leaves; Macroscopic; Microscopic; *Zamioculcas zamiifolia*

Introduction

Zamioculcas zamiifolia, commonly known as the Dollar Plant or ZZ Plant, originates from Kenya (East Africa) to South Africa. Its uniquely shaped, rounded, and glossy leaves resemble coins or dollars, hence the name "Dollar Plant." This species belongs to the Araceae family and is a popular indoor ornamental plant due to its pinnately arranged leaves that grow symmetrically on upright stems, creating a neat and balanced appearance (Croat & Ortiz, 2020; Younis et al., 2023). Moreover, the plant exhibits high adaptability to low-light and dry conditions and is resistant to pests and diseases (Chen & Henny, 2003; Zhang et al., 2023).

Beyond its decorative value, the ZZ plant is also used in traditional medicine (Muharini et al., 2018; Taghizadeh et al., 2023). The sap from its leaves is traditionally used by the people of Malawi to treat earaches (Hwang et al., 2020). Its roots are also utilized by the Sukuma community in northwestern Tanzania to relieve stomach problems (Kacholi et al., 2024). In addition, the ZZ plant serves as an effective phytoremediation agent capable of purifying indoor air from pollutants such as benzene, toluene, ethylbenzene, and xylene (BTEX) (Ravindra & Mor, 2022; Teiri et al., 2022).

Previous studies on *Zamioculcas zamiifolia* have mainly focused on propagation and its potential as an air pollutant remediator (Taghizadeh et al., 2023; Ulva, 2024). However, research on the macroscopic and microscopic characterization of its leaves remains limited. Therefore, this study aims to characterize the macroscopic and microscopic features of *Zamioculcas zamiifolia* leaves. The results are expected to provide descriptive information and serve as a useful scientific reference for future research and development.

How to Cite:
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Method

Research Design

This study was conducted qualitatively using a descriptive research design. The objective was to characterize the macroscopic and microscopic features of Dollar Plant leaves (*Zamioculcas zamiifolia* (Lodd.)). The research stages included plant determination, simplicia preparation, and macroscopic and microscopic observations of the leaves.

Population and Samples

The samples used in this study were Dollar Plants (*Zamioculcas zamiifolia*) obtained from a flower shop in Lamongan and powdered Dollar Plant leaves prepared in the Pharmacognosy Laboratory of Akademi Farmasi Surabaya. Some of the collected leaves were used for macroscopic and microscopic testing, while the remaining samples were processed into powder. Approximately five leaves and 1 gram of powdered *Zamioculcas zamiifolia* were required for microscopic observations.

Instruments

The instruments used in this study included a light microscope, object glass slides, cover slips, dropper pipettes, a spirit lamp (Bunsen burner), blender, analytical balance, sieve, smartphone for documentation, and stationery for recording observations. The materials used were Dollar Plant leaves and their powdered simplicia (*Zamioculcas zamiifolia* (Lodd.)), distilled water, chloral hydrate, alcohol, tissue, and observation sheets.

Procedure

Plant Determination

The first step before conducting the study was plant determination. This process aimed to identify the plant species accurately and confirm that the sample used was indeed *Zamioculcas zamiifolia*. The determination process was carried out at the Herbal Materia Medica Laboratory, Batu, Malang.

Simplicia Preparation

The preparation began with wet sorting, which involved removing unwanted materials such as dirt and nonessential plant parts. The selected green leaves were washed thoroughly with tap water and drained. The clean leaves were then cut into small pieces and air-dried for five days. After drying, a dry sorting process was conducted to remove remaining impurities, followed by powdering the simplicia using a blender and sieving with a 60-mesh sieve. The uniform powdered *Zamioculcas zamiifolia* leaves were stored in clean and dry containers (Pourhassan et al., 2023).

Organoleptic Examination

Organoleptic testing was performed on fresh Dollar Plant leaves and leaf powder, focusing on characteristics such as color and odor, and the results were documented (Novitasari et al., 2020).

Macroscopic Examination

The macroscopic test aimed to determine the distinctive characteristics of the simplicia through direct observation, either with or without a magnifying glass. This method identified the morphological features based on the shape and distinguishing characteristics of the Dollar Plant leaves (Naser, 2024).

Microscopic Examination

The microscopic test involved making very thin longitudinal and transverse sections of Dollar Plant leaves. Both the thin leaf sections and powdered samples were placed on glass slides, then treated with distilled water or chloral hydrate and heated briefly over a Bunsen flame before being covered with a cover slip. Observations of fresh and powdered leaf samples were then conducted using a light microscope under 100× and 400× magnifications (Naser, 2024).

Data Analysis Techniques

The results of the macroscopic and microscopic observations were presented in the form of tables and figures, accompanied by descriptive (narrative) explanations.

Result and Discussion

The first stage before conducting the research was plant determination. Determination is the process of accurately identifying the plant species to ensure the correctness of the plant's identity that will be used as a research sample (Darma & Marpaung, 2020). The determination results of the Dollar Plant (*Zamioculcas zamiifolia*) conducted at the UPT Herbal Materia Medica Laboratory in Batu are as follows: Family: Araceae; Genus: *Zamioculcas;* Species: *Zamioculcas zamiifolia.*

Organoleptic Observation Results of Fresh Leaves and Leaf Powder of Dollar Plant (Zamioculcas zamiifolia)

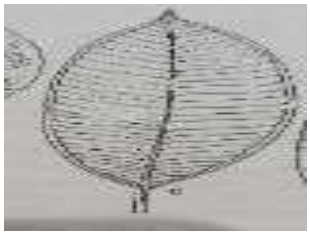
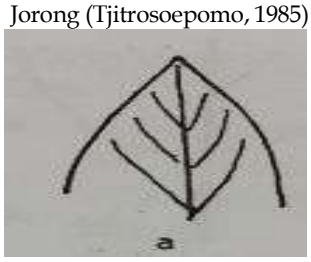
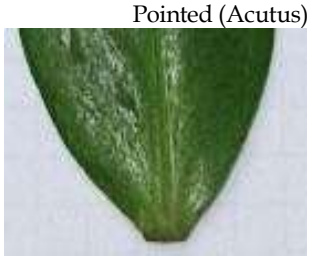
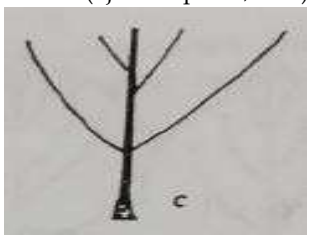
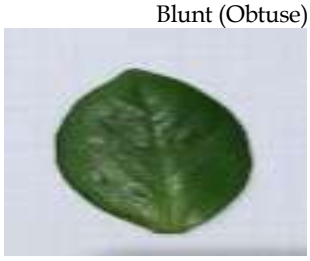
The organoleptic examination aims to provide an initial, objective, and simple identification of the fresh leaf and powdered leaf samples of *Zamioculcas zamiifolia* using the human senses. Table 1 shows that the upper surface of the Dollar Plant leaf is dark green, while the lower surface is yellowish green, with a characteristic leaf odor. The organoleptic observation of the leaf powder revealed a yellowish green color and a characteristic leaf odor. Next, the results of the macroscopic characterization of Dollar Plant leaves

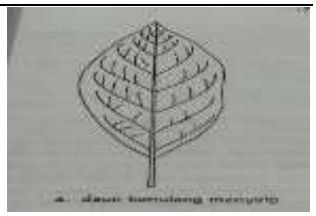
(*Zamioculcas zamiifolia* (Lodd.)) are presented in the Table 2.

Table 1. Organoleptic Observation Results of Fresh Leaves and Leaf Powder of *Zamioculcas zamiifolia*

Description	Observation Results	
	Leaf	Powder Leaf
Color	Upper surface: Dark green Lower surface: Light green	Yellowish green
Odor	Characteristic leaf odor	Characteristic leaf odor

Table 2. Macroscopic Characteristics of Dollar Plant (*Zamioculcas zamiifolia*) Leaves

No	Description	Observation Results	Literature
1	Leaf	 Upper surface Lower surface	 (Ulva, 2024)
2	Leaf blade		
	A. Leaf shape	 Jorong (Ovalis)	 Jorong (Tjitrosoepomo, 1985)
	B. Leaf apex	 Pointed (Acutus)	 Acutus (Tjitrosoepomo, 1985)
	C. Base of leaf	 Blunt (Obtuse)	 Obtuse (Tjitrosoepomo, 1985)
	D. Leaf surface	 Smooth shiny (Nitidus)	 Nitidus (Ulva, 2024)

No	Description	Observation Results	Literature
	E. Leaf veins	 Pinnate (Pennninervis)	 Penninervis (Tjitrosoepomo, 1985)
	F. Leaf edge	 Entire	 Entire (Tjitrosoepomo, 1985)
3	Leaf size		
	A. Leaf length	Average = ±10.68 cm	-
	B. Leaf width	Average = ±5.16 cm	-
4	Leaf color	Upper suface : Dark green Lower surface : Light green	Upper surface: Dark green (Chen & Henny, 2003)

Based on Table 1, the macroscopic observation results show that the dollar plant leaves (*Zamioculcas zamiifolia* (Lodd.)) have an oblong shape with entire margins and pinnate venation. The dollar leaf also has distinctive characteristics, namely a pointed apex and a rounded base. In addition, the dark green, smooth, and glossy surface is one of the most characteristic features of this plant. The average length and width of the dollar leaves are approximately ±10.68 cm and ±5.16 cm, respectively. These macroscopic observation results are consistent with the literature used, namely (Chen & Henny, 2003; Tjitrosoepomo, 1985; Ulva, 2024). Organoleptic observation was carried out to examine the color, odor, and taste of the leaves and leaf powder of the dollar plant (*Zamioculcas zamiifolia* (Lodd.)). The results obtained are presented in Table 3 as follows.

Table 3. Organoleptic Observation Results of Fresh Leaves and Leaf Powder of the Dollar Plant

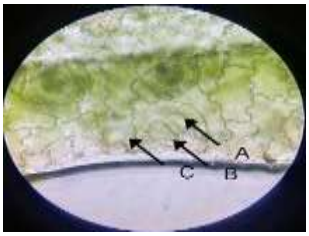
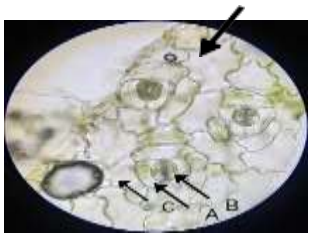
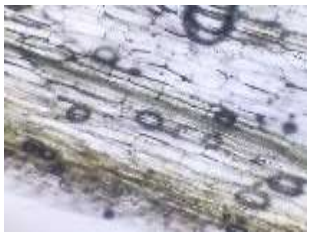
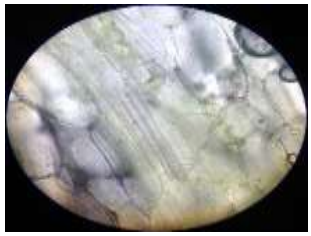
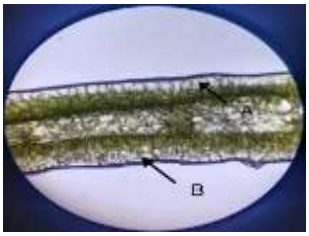
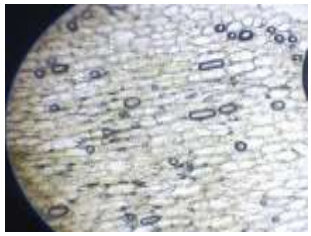
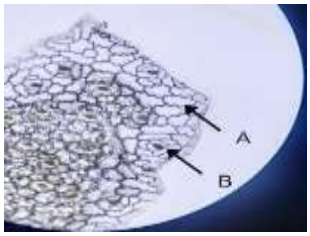
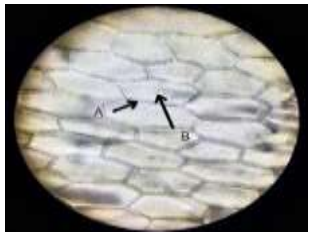
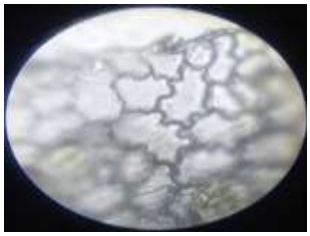
Description	Observation Results	
	Leaf	Powder Leaf
Color	Upper surface: Dark green Lower surface: Light green	Yellowish green
Odor	Odorless	Characteristic leaf odor
Taste	Tasteless	Tasteless

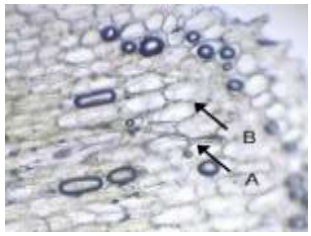
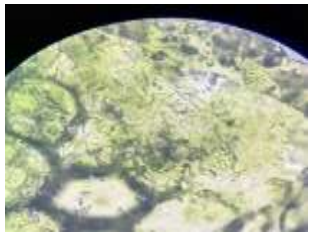
The results of the organoleptic observations conducted on the dollar plant (*Zamioculcas zamiifolia* (Lodd.)) showed that the upper surface of the leaf is dark green, while the lower surface is light green, and the leaves are odorless and tasteless. Meanwhile, the organoleptic observation of the leaf powder showed that the dollar leaf powder is yellowish-green in color, has a characteristic leaf odor, and is tasteless. Microscopic observations of the leaves and leaf powder of the dollar plant revealed several specific fragments, which can be seen in Figure 1 and Table 4.

Stomata | Spiral vascular bundle | Epidermal cell | Unicellular trichome | Calcium oxalate

Figure 1. Microscopic observation results of dollar leaf powder

Table 4. Results of Microscopic Observations of Dollar Leaves

No.	Description	Observation Results		
		Cross section	Upper longitudinal section	Lower longitudinal section
1.	Stomata	 100x	-	 100x
		 400x		 400x
2.	Spiral vascular bundle	 100x	 100x	 100x
		 400x	 400x	 400x
3	Epidermal cell	 100x	 100x	 100x
			 400x	 400x

No.	Description	Observation Results		
		Cross section	Upper longitudinal section	Lower longitudinal section
4	Trichome	 400x	 100x	-
5	Calcium Oxalate Crystal	 400x	-	-

The specific fragments obtained from the microscopic observation of fresh leaves and leaf powder of the dollar plant (*Zamioculcas zamiifolia* (Lodd.)) include unicellular and multicellular trichomes, paracytic-type stomata, epidermal cells, spiral-type vascular bundles, and needle-shaped calcium oxalate crystals. The stomata found in *Zamioculcas zamiifolia* are usually of the parasitic type (often referred to as rubiaceae) (Sriprapat et al., 2014; Vaidya, 2016; Viranda et al., 2024), which indicates that each stoma is surrounded by two adjacent cells parallel to the stomatal opening (Coiro et al., 2021). Similar to other vegetation, the stomata found on dollar leaves serve as a site for gas exchange (carbon dioxide comes in, oxygen goes out) and transpiration (evaporation of water) (Harrison et al., 2020).

Dollar leaves contain xylem and phloem within the vascular bundles. Xylem and phloem function to transport the products of photosynthesis, minerals, and water (Barclay, 2015; Konrad et al., 2018). Dollar leaves have epidermal cells arranged tightly together and lack large intercellular spaces, which also plays a role in water conservation (Carrillo-López & Yahia, 2018). They also have unicellular trichomes, similar to those found in hibiscus plants. *Zamioculcas zamiifolia* contains insoluble calcium oxalate crystals, making it somewhat toxic (Valenzona, 2023). This aligns with the findings of research by Gamage (2020). When ingested or applied to the skin, the needle-shaped crystals cause irritation, mouth sores, swelling, and digestive problems in both animals and humans (Friday, 1987). These calcium oxalate crystals serve as a form of self-defense in herbivorous plants (Sahu et al., 2020). Calcium oxalate is found in almost all members of the Araceae family (the taro family) (Jdeed et al., 2024).

Conclusion

The results of this study can be concluded as follows based on the macroscopic examination, the fresh leaves of the dollar plant have an oval (ovalis) shape, a pointed apex (acutus), a blunt base (obtuse), pinnate venation (penninervis), a smooth and glossy surface (nitidus), and an entire margin (entire). The dollar leaf has an average length of ±10.68 cm and an average width of ±5.16 cm. The organoleptic examination showed that the upper surface of the dollar leaf is dark green, while the lower surface is light green, and the leaf is odorless and tasteless. The leaf powder was observed to have a yellowish-green color, a characteristic odor similar to tea, and no distinctive taste, similar to that of the fresh leaf. The microscopic observation revealed several identifying fragments of both fresh leaves and leaf powder, such as unicellular trichomes, paracytic-type stomata, an upper epidermis with an irregular round shape, and a lower epidermis with an undulating form. Spiral vascular bundles were also identified in both the fresh leaves and the leaf powder, along with needle-shaped calcium oxalate crystals.

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Author Contributions

Conceptualization, S.; methodology, S.; resources, S and A.N.S.P.B.; writing of the original draft, preparation of the manuscript by S and A.N.S.P.B.

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Conflicts of Interest
The authors declare no conflict of interest.

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