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THE ACTIVE COMPOUNDS IN POLYSCIAS SCUTELLARIA IDENTIFIED BASED ON THE SOLVENT

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ABSTRACT
Polyscias scutellaria, commonly known as bowl leaf, is a medicinal plant belonging to the Araliaceae family, renowned for its diverse therapeutic properties, particularly in Southeast Asia. The plant is traditionally used for its antioxidant, anti-inflammatory, and other health benefits, attributed to its rich array of bioactive compounds, such as phenolics, flavonoids, saponins, and alkaloids. Objective to explore the phytochemical composition and antioxidant potential of various extracts of Polyscias scutellaria to assess its pharmacological significance and therapeutic applications. The study employed qualitative and quantitative analyses to identify active compounds in Polyscias scutellaria extracts, using extraction methods including 96% ethanol, ethyl acetate, and methanol. Phytochemical screening was performed, and antioxidant activity was evaluated using the DPPH method. The phytochemical screening revealed a rich profile of bioactive compounds, including phenolics, flavonoids, saponins, and alkaloids. The 96% ethanol extract showed a phenolic content of 14.67 ± 0.33 mg GAE/g and a flavonoid content of 1.83 ± 0.05 mg QE/g, while the ethyl acetate extract exhibited the highest total phenolic content of 289.813 ± 11.381 mg GAE/g. Antioxidant activity analysis demonstrated significant scavenging effects, with the ethanol extract achieving an IC50 value of 46.28 mg/mL. The methanol extract contained higher concentrations of alkaloids, carbohydrates, and saponins, indicating potential for functional health applications. This study underscores the pharmacological significance of Polyscias scutellaria and its bioactive constituents, highlighting its potential as a natural antioxidant source and functional ingredient. Further research is warranted to validate its therapeutic efficacy and explore its applications in drug discovery and modern health practices.

Keywords: polyscias scutellaria; the active compounds; the solvent

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INTRODUCTION

Indonesia is abundant in medicinal plants known for their effectiveness in treating and preventing diseases (Alkandahri, MY; Subarnas, A., 2018). These plants, an integral part of Indonesia's cultural heritage, have been utilized since ancient times to support health and cure ailments. The knowledge of their uses has been handed down through generations (Alkandahri, MY.; Berbudi, A., Utami, NV.; Subarnas, 2019; Alkandahri, MY.;Maulana, YE.;Subarnas, A.;Kwarteng, A.;Berbudi, 2020). Among these plants is Polyscias scutellaria, commonly referred to as mangkokan, which is known by various regional names, in Java, it is commonly called godong mangkokan, while in Sunda it is referred to as mamanukan, mamangkokan, or pohon mangkok. In Madura, it goes by puring or daun koin, and in Ambon, it is known as daun koin or daun papeda. Additional names include mangkok-mangkok in Makassar and Ujung Pandang, tuwa mangku in North Sulawesi, goma matari and sawoko in Halmahera, rau paroro in Ternate, and bobokang. These variations in naming highlight the plant's extensive presence and cultural importance throughout the region (D.F., 2012; Mike., 2017; N.K., 2016; Wijaya., 2018).Polyscias scutellaria, commonly referred to as bowl leaf, is a member of the Araliaceae family and is recognized for its significant medicinal properties and traditional uses in Southeast Asia (Goh, B. H., Tee, T. T., & Ibrahim, 2014). The plant's

leaves are known for their unique bowl shape and are utilized in traditional medicine for their purported health benefits, which include antioxidant, anti-inflammatory, immunomodulatory, and cardiovascular protective effects (Tiwari, P., Kaur, N., & Kaur, 2011). The therapeutic potential of Polyscias scutellariais largely attributed to its rich array of bioactive compounds, including flavonoids, polyphenols, saponins, tannins, and alkaloids (Khan, M. A., Ahmad, A., & Khan, 2015; Nguyen, T. M., Nguyen, H. T., & Le, 2019).

The extraction process requires selecting solvents that are compatible with the properties of the active compounds to be isolated. Polar solvents, like water, ethanol, and methanol, are typically used to extract polar compounds such as alkaloids, flavonoids, saponins, and tannins. Ethanol, particularly in concentrations like 70% or 95%, is widely favored due to its versatility. Semi-polar solvents, such as ethyl acetate and acetone, are ideal for extracting semi-polar compounds like flavonoids and coumarins, while non-polar solvents like n-hexane and chloroform are preferred for isolating non-polar compounds like essential oils, lipids, and sterols. In some cases, mixtures of solvents, like methanol-chloroform or ethanol-water, are used to improve the extraction of compounds with different polarities. The selection of a solvent also considers factors such as safety, purity, cost, and environmental impact, ensuring the best fit for the extraction process (AgroMedia, 2008; Ahdiyah & Purwani, 2015; Alfinda Novi Kristanti, 2019; Christin Aprillian , Beama. Maria Ekarista, Klau. Natalia Godinho de, 2021; D.F., 2012; Hariana;, 2013; Lestario & Press, 2018; Oktaviani & Al Zahra, 2024; Rollando, 2019; Roosheroe;, 2014; Setiawan Dalimartha, 1999).

Research into the phytochemical composition of Polyscias scutellaria has demonstrated significant antioxidant activity attributed to the presence of phenolic compounds and flavonoids. These compounds are known for their ability to scavenge free radicals and reduce oxidative stress, which is a contributing factor to various chronic diseases, including cancer (Huzaemah et al., 2024). The Folin-Ciocalteu method, commonly used for quantifying total phenolic content, has shown that the leaves of Polyscias scutellaria have an average phenolic content of 14.67 ± 0.33 mg GAE/g, highlighting its potential as a natural antioxidant source (Muhar et al., 2023).The presence of saponins and tannins further emphasizes the therapeutic potential of Polyscias scutellaria. Saponins are recognized for their anti-inflammatory and immunomodulatory properties, while tannins are known for their ability to stabilize membranes and exhibit antimicrobial activity (Nasution et al., 2021). Additionally, the examination of various extraction methods, including the use of ethanol, ethyl acetate, and methanol, has yielded promising results in terms of the extraction efficiency of these bioactive compounds (Muhar et al., 2023).

Given the pharmacological significance of Polyscias scutellaria , the present study aims to investigate the active compounds present in various extracts of this plant, including their antioxidant, anti-inflammatory, and potential cytotoxic activities. Through qualitative and quantitative analyses, this research will provide insight into the therapeutic applications of Polyscias scutellaria and its extracts in the context of drug discovery.The purpose of this research is to explore the phytochemical composition and antioxidant potential of various extracts from Polyscias scutellaria, a medicinal plant known for its therapeutic properties. The study aims to identify and quantify bioactive compounds such as phenolics, flavonoids, saponins, and alkaloids, which contribute to the plant’s medicinal benefits, and to evaluate its potential as a natural source of antioxidants and functional health ingredients. By using different solvents—96% ethanol, ethyl acetate, and methanol—the research will investigate how solvent polarity influences extraction efficiency and bioactivity. The objectives include identifying active compounds in Polyscias scutellaria extracts, quantifying their total phenolic and flavonoid content, and correlating these with antioxidant activity measured by the DPPH

assay. Additionally, the study will compare the effectiveness of different solvents, assess the antioxidant potential by determining IC50 values, and explore the therapeutic applications of these extracts in antioxidant, anti-inflammatory, and immunomodulatory contexts. Ultimately, the research aims to contribute to the development of Polyscias scutellaria as a valuable natural product with potential pharmacological applications, supporting its use in modern health practices and drug discovery.

METHOD

The literature review aimed to consolidate research on Polyscias scutellaria, focusing on its phytochemical properties, antioxidant potential, and therapeutic applications. A systematic search was conducted across databases like PubMed, Google Scholar, and ScienceDirect, using keywords such as "Polyscias scutellaria," "antioxidant activity," and "bioactive compounds." Relevant studies from 2000 to 2024 were selected. The review categorized the literature into themes such as phytochemical composition, extraction methods, antioxidant assays, and therapeutic potential, highlighting the plant's rich content of phenolics, flavonoids, saponins, and alkaloids.

RESULT

Table 1.
The 96% Ethanol

Active Compounds	Method	Interpretation
Phenolic	Magnesium powder and 2-4 drops of concentrated hydrochloric acid (HCl)	+
	Folin-Ciocalteu	14.67 ± 0.33 mgGAE/g
Flavonoid	2-3 drops of ferric chloride (FeCl3)	+
	Colorimetric / Aluminum chloride	1.83 ± 0.05 mgQE/g
Alkaloid	Mayer	-
	Dragendorff	+
Flavonoid	Magnesiun strip and HCl	+
Saponin	Shaking ang HCL	+
Tannin	Ferric (III) Chloride	+
Terpenoid	Libermann-Burchard	+

Tabel 1 : Active compounds in 96% Ethanol Extract of Polyscias scutellaria. The 96% ethanol extract of Polyscias scutellaria was qualitatively identified to contain phenolic and flavonoid compounds. The presence of phenolic compounds was indicated by a blackish-green color, with the total phenolic content measured using the Folin-Ciocalteu method found to be an average of 14.67 ± 0.33 mg GAE/g (Nur et al., 2020). Additionally, the flavonoid compounds were identified by the appearance of an orange color in qualitative analysis, with the total flavonoid content determined via the aluminum chloride method averaging 1.83 ± 0.05 mg QE/g (Nur et al., 2020). Alkaloids were tested using Mayer and Dragendorff reagents, showing no precipitate with Mayer but a positive reaction (precipitate formation) with Dragendorff. Flavonoids were confirmed by a color change to red when using a magnesium strip and HCl, indicating their presence. The test for saponins, which involved shaking the solution with HCl, resulted in stable foam formation, confirming the presence of saponins. Tannins were detected by the dark green color that developed when ferric (III) chloride was added. Lastly, terpenoids were identified through the Liebermann-Burchard test, which produced a purple color, indicating their presence in the sample (Huzaemah et al., 2024).

Table 2.
Phytochemical Screening Results of Mangkokan (Polyscias scutellaria) Leaf Extract

Active Compounds	Method	Interpretation
Alkaloids	Bouchardart	+
	Maeyer	-
	Wagner	+
	Dragendorff	+
	Salkowsky	-
Triterpenoids and Steroids	Lieberman-Burchard	-
Saponins	Aquadest + Alkohol 96%	+
	$FeCl_3$ 5%	+
Flavonoids	Mg + HCl	-
	H_2SO_4 (dilute)	-
Tannins	$FeCl_3$ 1%	+

The phytochemical screening of Mangkokan leaf ethanol extract (Polyscias scutellaria) revealed the presence of several bioactive compounds. Alkaloids were detected using the Bouchardart, Wagner, and Dragendorff methods, but the Maeyer and Salkowsky tests were negative, indicating that not all alkaloid subtypes were present. Triterpenoids and steroids were absent, as indicated by the negative Lieberman-Burchard test. Saponins were present, confirmed by both the Aquadest + alcohol 96% method and the $FeCl_3$ 5% test. Flavonoids were not detected, as both the Mg + HCl and dilute H_2SO_4 tests were negative. Lastly, tannins were found in the extract, as shown by the positive result in the $FeCl_3$ 1% test. This screening suggests that Polyscias scutellaria contains alkaloids, saponins, and tannins, but lacks triterpenoids, steroids, and flavonoids (Nasution et al., 2021).

Table 3.
Antioxidant Activity (IC_{50}), Total Phenolic, and Total Flavonoid Content of Polyscias scutellaria Extracts

No	Sample	IC_{50} (mg/mL)	Total Phenolic Content (mg GAE/g)	Total Flavonoid Content (mg/g)
1.	Ethanol Extract of PS (EEPS)	46.28	250.284 ± 9.381	25.4 ± 2.18
2.	Ethyl Acetate Extract of PS (EAPS)	52.67	289.813 ± 11.381	20.38 ± 1.28
3.	n-Hexane Extract of PS (nhPS)	72.33	20.41 ± 2.34	5.18 ± 0.817
4.	Vitamin C (VC)	12,31	-	-

The antioxidant activity of Polyscias scutellaria (PS) extract and its fractions was evaluated using the DPPH method, revealing significant findings. At a concentration of 15.625 µg/mL, the extract demonstrated a 20.95% scavenging activity for DPPH, with activity increasing as the concentration rose, indicating a positive correlation between extract concentration and antioxidant effect. Notably, the scavenging effect of PS was found to be higher than that of Vitamin C (VC) at equivalent doses. The antioxidant capacities of the different samples were ranked in the following order: Vitamin C (VC) > Ethanol Extract of PS (EEPS) > Ethyl Acetate Extract of PS (EAPS) > n-Hexane Extract of PS (nhPS). The IC50 values, which indicate the concentration required to inhibit 50% of DPPH radicals, were determined as follows: VC at 12.31 mg/mL, EEPS at 46.28 mg/mL, EAPS at 52.67 mg/mL, and nhPS at 72.33 mg/mL. Additionally, the total phenolic content was highest in the EAPS fraction, measuring 289.813 ± 11.381 mg GAE/g dried extract, followed by EEPS with 250.284 ± 9.381 mg GAE/g, and the lowest was found in nhPS at 20.41 ± 2.34 mg GAE/g. The total flavonoid content mirrored these trends, with EEPS exhibiting the highest level at 25.4 ± 2.18

mg/g, followed by EAPS at 20.38 ± 1.28 mg/g, and nhPS at 5.18 ± 0.817 mg/g (Muhar et al., 2023).

Table 4.
This table provides the qualitative analysis of various phytochemical constituents present in MEPSL (Methanol Extract of Polyscias scutellaria Leaves)

No	Active Compounds	Interpretation
1.	Alkaloid	++
2.	Carbohydrate	++
3.	Saponin	++
4.	Glycoside	+
5.	Reducing Sugar	+
6.	Flavonoid	+
7.	Tannin	-
8.	Steroid	-

Note:
- (++) indicates a higher amount.
- (+) indicates a moderate amount.
- (–) indicates absence.

The table indicates the presence of various phytochemical constituents in the extract, showing a higher concentration of alkaloids, carbohydrates, and saponins (++), and moderate amounts of glycosides, reducing sugars, and flavonoids (+). Tannins and steroids were absent (−). The extract of Polyscias scutellaria leaves was obtained through the cold maceration method, where 80 g of powdered leaves were soaked in 600 mL of methanol for 10 days in a sealed round-bottom flask. The mixture was then filtered and air-dried for an additional 7 days, yielding 16.15 g of leaf extract (Willy Tirza Eden, 2006).

DISCUSSION

This study underscores the significant pharmacological potential of Polyscias scutellaria as a natural source of bioactive compounds, particularly phenolics, flavonoids, saponins, and alkaloids. The choice of solvents played a crucial role in the extraction efficiency of these compounds. Ethanol, a polar solvent, was highly effective in extracting phenolic compounds and flavonoids, which aligns with previous findings by Goh et al. (2014) that highlighted the solubility of these compounds in polar solvents. Ethyl acetate extract demonstrated the highest total phenolic content (289.813 ± 11.381 mg GAE/g), corroborating studies by Khan et al. (2015), which indicated the efficiency of medium-polar solvents in isolating specific phenolic subgroups. Methanol extracts, on the other hand, showed higher concentrations of alkaloids, carbohydrates, and saponins, reinforcing its suitability for extracting polar compounds, as reported by Nguyen et al. (2019).The antioxidant activity of Polyscias scutellaria was significant, particularly in the ethanol and ethyl acetate extracts, with IC50 values of 46.28 mg/mL and 52.67 mg/mL, respectively. Although these values were lower than synthetic antioxidants like Vitamin C (IC50 = 12.31 mg/mL), the results affirm the ability of phenolic and flavonoid compounds to scavenge free radicals effectively. This finding aligns with Tiwari et al. (2011), who emphasized the hydroxyl groups in phenolic compounds as key contributors to antioxidant activity. Moreover, the scavenging activity observed in this study mirrored trends reported by Muhar et al. (2023), demonstrating a positive correlation between phenolic content and antioxidant capacity.

The presence of saponins and tannins further highlights the therapeutic potential of Polyscias scutellaria. Saponins are known for their immunomodulatory and anti-inflammatory properties, while tannins exhibit astringent and antimicrobial effects, as documented by Nasution et al. (2021). Additionally, the methanol extract's high concentration of alkaloids

emphasizes its potential as a functional health ingredient, aligning with Nguyen et al. (2019), who highlighted the cytoprotective properties of alkaloids. Comparatively, ethanol proved to be the most versatile solvent, effectively extracting a wide range of phytochemicals, including phenolics and flavonoids. Ethyl acetate excelled in phenolic compound extraction, while methanol was superior in isolating alkaloids and saponins. These results validate the findings of Khan et al. (2015), which advocate for solvent selection based on target compounds.The study's findings pave the way for further exploration into Polyscias scutellaria as a source of multifunctional therapeutic agents. Advanced techniques such as high-performance liquid chromatography (HPLC) and mass spectrometry could provide more precise characterization and quantification of the bioactive compounds. Additionally, in vivo and clinical studies are essential to validate the pharmacological properties and therapeutic efficacy of this plant, ensuring its potential applications in drug discovery and modern health practices.

CONCLUSION

The study comprehensively analyzed the active compounds present in Polyscias scutellaria using various extraction methods, highlighting the plant's potential as a source of bioactive compounds with significant therapeutic applications. The qualitative and quantitative assessments demonstrated the presence of essential phytochemicals, including phenolics, flavonoids, saponins, and alkaloids, across different solvent extracts. Notably, the 96% ethanol extract revealed substantial phenolic and flavonoid content, while the ethyl acetate extract showed the highest total phenolic content, indicating its efficiency in extracting valuable compounds. Furthermore, the antioxidant activity analysis illustrated that the ethanol extract exhibited potent scavenging activity against DPPH radicals, outperforming the n-hexane extract. The methanol extract showed a higher concentration of alkaloids, carbohydrates, and saponins, suggesting its potential as a functional ingredient in health applications. Overall, Polyscias scutellaria demonstrates promising pharmacological properties, warranting further investigation into its efficacy for therapeutic purposes and potential applications in drug discovery.

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