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Pharmacognosy Study of *Guazuma ulmifolia* Lam. Leaves

Tina Rostinawati[1*], Yasmiwar Susilawati[1], Ami Tjitraresmi[1], Syifa Zakia[1], Hanny Nugrahani[1], Sri Rahayu Widya Ningrum[2], Pinastya Purwakaning Kusumastuti[2], Widya Ayu Sulistyaningsih[2]

[1]Department of Pharmacy Biology, Faculty of Pharmacy, Padjadjaran University, West Java, Indonesia

[2]PT Nose Herbal Indo, Kirana Two Office Tower, 12th Floor, Units A–B, Kelapa Gading, North Jakarta, DKI Jakarta, Indonesia

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*Corresponding author: t.rostinawati@unpad.ac.id

Abstract

Guazuma ulmifolia Lam., known as Jati Belanda, has been extensively used in traditional medicine because of its various pharmacological properties. This study aimed to evaluate the pharmacognostic features, phytochemical profile, and quality parameters of *G. ulmifolia* leaves. The dried leaves were extracted with 70% ethanol through maceration, and the extract's organoleptic, microscopic, and macroscopic characteristics, moisture content, extractive values, ash content, metal contamination, and phytochemical composition were analyzed. Phytochemical screening identified flavonoids, phenolics, saponins, coumarins, and monoterpenoids/sesquiterpenoids. Thin Layer Chromatography (TLC) confirmed the presence of flavonoids with quercetin as a standard. Quantitative analysis showed a total phenolic content of 2.1 ± 0.297 mg GAE/g and a total flavonoid content of 1.27 ± 0.12 mg QE/g of extract. All metal contamination levels, including Pb, Cd, and Hg, were within the safe limits. These findings support the potential of *G. ulmifolia* leaves as a safe and standardized raw material for herbal medicine.

Keywords: *Guazuma ulmifolia* Lam., Pharmacognosy study, Phytochemical screening

Studi Farmakognosi Daun *Guazuma ulmifolia* Lam.

Abstrak

Guazuma ulmifolia Lam., yang umum dikenal sebagai Jati Belanda, telah banyak digunakan dalam pengobatan tradisional karena berbagai sifat farmakologisnya. Penelitian ini bertujuan untuk mengevaluasi karakteristik farmakognostik, profil fitokimia, dan parameter kualitas dari daun *G. ulmifolia*. Daun kering diekstraksi menggunakan etanol 70% melalui metode maserasi, kemudian ekstrak dianalisis berdasarkan karakteristik organoleptik, mikroskopik, dan makroskopik, kadar air, nilai ekstraktif, kadar abu, kontaminasi logam, serta komposisi fitokimia. Skrining fitokimia mengidentifikasi keberadaan flavonoid, fenolik, saponin, kumarin, dan monoterpenoid/seskuiterpenoid. Kromatografi Lapis Tipis (KLT) mengonfirmasi keberadaan flavonoid dengan quercetin sebagai pembanding. Analisis kuantitatif menunjukkan kadar total fenolik sebesar 2,1 ± 0,297 mg GAE/g dan total flavonoid sebesar 1,27 ± 0,12 mg QE/g ekstrak. Seluruh kadar kontaminasi logam, termasuk Pb, Cd, dan Hg, berada dalam batas aman. Temuan ini mendukung potensi daun *G. ulmifolia* sebagai bahan baku herbal yang aman dan terstandar.

Kata Kunci: *Guazuma ulmifolia* Lam., studi farmakognosi, skrining fitokimia

1. Introduction

Guazuma ulmifolia Lam. (Malvaceae) is a tree commonly known as "mutamba" and "guácimo" and is prevalent in Latin America, particularly Brazil and Mexico. It has a history of being used as a traditional medicine in various countries and among different tribes, including Mexico, Brazil, Bolivia, Cuba, Honduras, Ecuador, and Guatemala. In Indonesia, *G. ulmifolia* is easily found in Java and Sumatra. *G. ulmifolia* is known as "Jati Londo" in Javanese and "Jati blando" in Sumatera.[1,2]

Ethnopharmacology studies have reported that parts of *G. ulmifolia*, such as the leaf, flower, fruit, stem bark, and root, possess various medicinal properties.[2] Its leaves have been found to have anti-obesity, antidiabetic, anticancer, antimicrobial, antioxidant, and anti-inflammatory activities.[3] These pharmacological effects are attributed to the presence of key secondary metabolites, such as phenolic acids (chlorogenic acid and caffeic acid) and flavonoids, including catechin, quercetin, and luteolin.[4]

Given its rich phytochemical profile, ensuring the quality and consistency of *G. ulmifolia* as a medicinal plant is essential. The therapeutic efficacy of medicinal plants depends on the quality and quantity of their chemical constituents. Pharmacognostic studies help authenticate plant materials and establish standardization parameters, thereby ensuring the reproducible quality, safety, and efficacy of herbal products.[5]

2. Methods

2.1. Instruments

An autoclave (Hirayama Autoclave HVE-50, Japan), a Gas Chromatograph (Agilent Technologies 7890 with Auto Sampler and 5975 Mass Selective Detector, US), and the ChemStation data system were used in this study. Other equipment included an incubator (Yenaco, China), filter paper, a Laminar Air Flow (LAF) cabinet, a refrigerator, a caliper (Tricle brand, China), a macerator, micropipettes (Thermo Fisher Scientific, US), 96-well U-bottom microplates (NEST, China), 96-well flat-bottom microplates, 96-well round-bottom microplates (NEST, China), 24-well microplates (NEST, China), a microplate reader (BioTek Epoch, US), a multichannel micropipette, an inoculating loop, an oven (Memmert, Germany), a rotary evaporator (IKA RV 10, Germany), a UV-Vis spectrophotometer (WPA Biowave, US), a vortex mixer, a water bath (Memmert, Germany), and an analytical scale (Mettler Toledo, Swiss).

2.2. Materials

Plant materials, chemical standards, solvents, and reagents were used in this study. The primary plant material was *G. ulmifolia* dried leaves. The chemical standards included gallic acid for phenolic content determination and quercetin for flavonoid content analysis. A range of solvents and reagents were used, such as 1% gelatin solution, 1% sodium hydroxide (NaOH), 10% ammonium hydroxide (NH_4OH), 10% vanillin solution in sulfuric acid, 2 N diluted hydrochloric acid (HCl), concentrated nitric acid (HNO_3), 70% ethanol, 70% perchloric acid ($HClO_4$), potassium hydroxide (KOH), 10% aluminum chloride ($AlCl_3$), analytical-grade ethanol, analytical-grade methanol, chloroform, Dragendorff's reagent, ether, 1% ferric chloride solution, Liebermann-Burchard reagent, Mayer's reagent, 1 M sodium acetate, and 7.5% Folin–Ciocalteu reagent.

2.3. Procedures

2.3.1. Extraction

The dried leaves of *G. ulmifolia* were roughly ground using a grinder and then subjected to extraction using a maceration technique with 70% ethanol. After the mixtures were filtered, the liquids were evaporated under reduced pressure using a rotary evaporator operating at 60 rpm and 50°C. The resulting evaporated extract was condensed in a water bath at 60°C. The percentage yield of the extracts was determined using the following formula:

[% yield = (Weight of dried extract/Initial weight of dried leaves) × 100]

2.3.2. Moisture Content

The water content was determined by

weighing approximately 5 g of the dried extract. The sample was placed on a moisture balance and heated until a constant weight was obtained.

2.3.3. Organoleptic Test

Organoleptic parameters are described by observing the extract's shape, color, odor, and taste.

2.3.4. Microscopic

Microscopic observations were carried out at 40x and 100x magnification with an electronic microscope connected to an OptiLab® camera, which allowed images to be observed and taken using a computer. The observed fragments were compared with those listed in the Indonesian Herbal Pharmacopoeia.

2.3.5. Macroscopic

Macroscopic observations were carried out by placing six dried leaves of *G. ulmifolia* on white paper and comparing their morphological characteristics with those described in the Indonesian Herbal Pharmacopeia.

2.3.6. Water-Soluble Extractives Content

G. ulmifolia dried leaf powder (5 g) was soaked in chloroform-saturated water (100 mL) for 24 h. The extract was then filtered and transferred into a 20 mL evaporator cup to be dried in an oven at 105°C until the weight stabilized. The percentage of water-soluble extractives was calculated using the following formula:

[(Weight of dried extract/Initial weight of dried leaves) x 5 x 100]

2.3.7. Ethanol-Soluble Extractives Content

G. ulmifolia dried leaf powder (5 g) was soaked in 100 mL of analytical-grade ethanol for 24 h. The extract was then filtered and transferred into a 20 mL evaporator cup to be dried in an oven at 105°C until the weight stabilized. The percentage of ethanol-soluble essence content was calculated using the following formula:

[(Weight of dried extract/Initial weight of dried leaves) x 5 x 100]

2.3.8. Total Ash Content

The ground sample (3 g) was weighed, ignited, and stored in a silicate crucible. The ignition was carried out at a temperature of 800°C until the weight remained constant, and the sample was then cooled and weighed. The total ash content was calculated using the following formula:

[(Ash weight/Initial sample weight) x 100]

2.3.9. Acid-Insoluble Ash Content

The ash obtained from the determination of the total ash content was boiled with 25 mL of diluted HCl for 5 min. The insoluble part was collected and filtered using ash-free filter paper, washed with hot water, and allowed to stand in a crucible at 800°C until the weight was constant. The acid-insoluble ash content was calculated using the following formula:

[(Acid -insoluble ash weight/Initial sample weight) x 100]

2.3.10. Metal Contamination Levels

In a 600 mL beaker, 2.5 g of the extract was carefully weighed. Then, 25 mL of concentrated HNO_3 was added, and the beaker was covered with a watch glass. The solution was then slowly boiled for 30 min to ensure the oxidation of easily oxidizable materials. Subsequently, 10 mL of 70% $HClO_4$ was slowly fused into the solution, which was slowly boiled until it almost lost its color. Subsequently, the solution was filtered, deionized water was introduced, filtered again, and diluted to 100 mL with deionized water. The cadmium (Cd), lead (Pb), and mercury (Hg) concentrations were determined by atomic absorption spectroscopy.[6]

2.3.11. Phytochemical Analysis

Phytochemical analysis was carried out in triplicate on the simplicia (raw material) and ethanol extract of *G. ulmifolia* leaves. The chemical constituents tested were saponins, phenolics, flavonoids, quinones, tannins,

coumarins, alkaloids, monoterpenoids/sesquiterpenoids, and triterpenoids/steroids.

2.3.12. Flavonoid Test

Shinod's test. The extract (1 mL) was combined with ten drops of 2 N HCl and a piece of magnesium. The development of a deep pink color indicated the presence of flavonoids7.

2.3.13. Phenolic Test

Ferric chloride test. An aqueous 1% $AlCl_3$ solution was used to expose a portion of the extract. The appearance of a deep blue or black color indicated the existence of phenolic compounds.[8]

2.3.14. Alkaloid Test

a. Dragendorff 's test. The extract (2 mL) was mixed with 1 mL of Dragendorff's reagent, and the formation of an orange-red precipitate confirmed the presence of alkaloids.

b. Mayer's test. The extract (2 mL) was combined with a few drops of Mayer's reagent. If a yellowish or white precipitate forms, it suggests the presence of alkaloids.[7]

2.3.15. Tannin Test

Gelatin Test. Extracts were boiled with 10 mL of water for several minutes. 1% gelatin solution was added to the extract. A white precipitate indicates the presence of tannins and phenolic components.[9]

2.3.16. Coumarin Test

The ethanolic extract (5 mL) was evaporated, and the residue was dissolved in 1–2 mL of hot distilled water. The resulting volume is divided into two parts. Half of the volume is taken as a witness, and another 0.5 mL of 10% NH_4OH is added to the other part. Two spots are placed on filter paper and examined under UV light. Coumarins are indicated by intense fluorescence.[10]

2.3.17. Saponin Test

A tube was used to mix a portion of the extract and the simplicia with 10 mL of water. The potential existence of saponins was confirmed by the presence of persistent foam after vigorous shaking.[8]

2.3.18. Quinone Test

Alcoholic KOH test. KOH was added to the sample's aqueous extract. The appearance of red to blue color indicates a positive reaction to quinones.[11]

2.3.19. Monoterpenoid and Sesquiterpenoid Test

The simplicial (1 g) is ground using a mortar, and 5 mL of ether was added. The extract was then pipetted and filtered to obtain the filtrate. The filtrate is placed in an evaporating dish and allowed to dry. A drop of a 10% vanillin solution in sulfuric acid is added. The formation of colors indicates the presence of mono- and sesquiterpenes.

2.3.20. Triterpenoid and Steroid Tests

The ethanolic extract (10 mL) were evaporated. The residue was treated with Liebermann-Burchard reagent. The appearance of a blue-green ring at the interphase indicated a positive reaction.[10]

2.3.21. Thin Layer Chromatography

The TLC test was performed according to the method listed in the Indonesian Herbal Pharmacopoeia with a slight modification, using silica gel as the stationary phase and chloroform, acetone, and formic acid with a ratio of 7:3:1 as the mobile phase. Methanol is used to dissolve the sample and quercetin as standard. After eluting, the TLC plate was sprayed with citroborate. The plate was then heated at 100°C for approximately 1 min and observed under UV light at 366 nm and 254 nm12.

2.3.22. Total Flavonoid Content

Analysis of total flavonoid content was carried out using the procedures listed in the Indonesian Herbal Pharmacopoeia. The extract (200 mg) was put into an Erlenmeyer flask, 25 mL of analytical-grade ethanol was added, and then the mixture was stirred for

30 min using a magnetic stirrer. The extract was then filtered and filled into a 25 mL volumetric flask. For the standard solution, 10 mg of quercetin was weighed and dissolved in 25 mL of analytical-grade ethanol, and then a series of dilutions of the standard solution was made with concentrations of 100, 75, 50, and 25 µg/mL.

The test solution and each series of standard solutions were pipetted separately into vials, each containing as much as 0.5 mL. Then, 1.5 mL analytical-grade ethanol, 0.1 mL 10% $AlCl_3$, 0.1 mL 1 M sodium acetate, and 2.8 mL of water were added. The mixture was shaken and left for 30 minutes at room temperature. Absorption was then measured with a UV-Vis spectrophotometer at 430 nm.

2.3.23. Total Phenolic Content

The total phenolic content was analyzed by referring to the Folin–Ciocalteu method procedure listed in the Indonesian Herbal Pharmacopoeia, slightly modifying the standard solution's dilution series. The extract (200 mg) was put into an Erlenmeyer flask, 25 mL of analytical-grade methanol was added, and then the mixture was stirred for 30 min using a magnetic stirrer. The extract was then filtered and filled into a 25 mL volumetric flask. For the standard solution, 10 mg of gallic acid was weighed and dissolved in 25 mL of analytical-grade methanol. The standard solution was diluted with concentrations of 320, 160, 80, 40, 20, and 10 µg/mL.

The test solution and each series of standard solutions were pipetted separately as much as 0.5 mL into vials, and then 2.5 mL of 7.5% Folin–Ciocalteu reagent was added to each. After 8 min, 2 mL of 1% NaOH was added to each test solution and each series of comparison solutions. The mixture was left for 1 hour in a dark vial. Absorption was then measured at a wavelength of 733 nm.

3. Results and Discussion

3.1. Characterization of Specific Parameters of *G. ulmifolia* Leaf

3.1.1. Organoleptic Test

The form, color, taste, and odor of the extract are described to evaluate the organoleptic criteria. According to observations, the sample was brown, had an astringent taste, and a slight, distinctive odor, all of which fit the Indonesian Herbal Pharmacopoeia description.[12]

3.1.2. Microscopic

Microscopic observations of *G. ulmifolia* leaf fragments are shown in Figure 1, highlighting six distinct anatomical structures under magnification. These microscopic features are in accordance with the standard pharmacognostic descriptions used for identifying and authenticating *G. ulmifolia* in

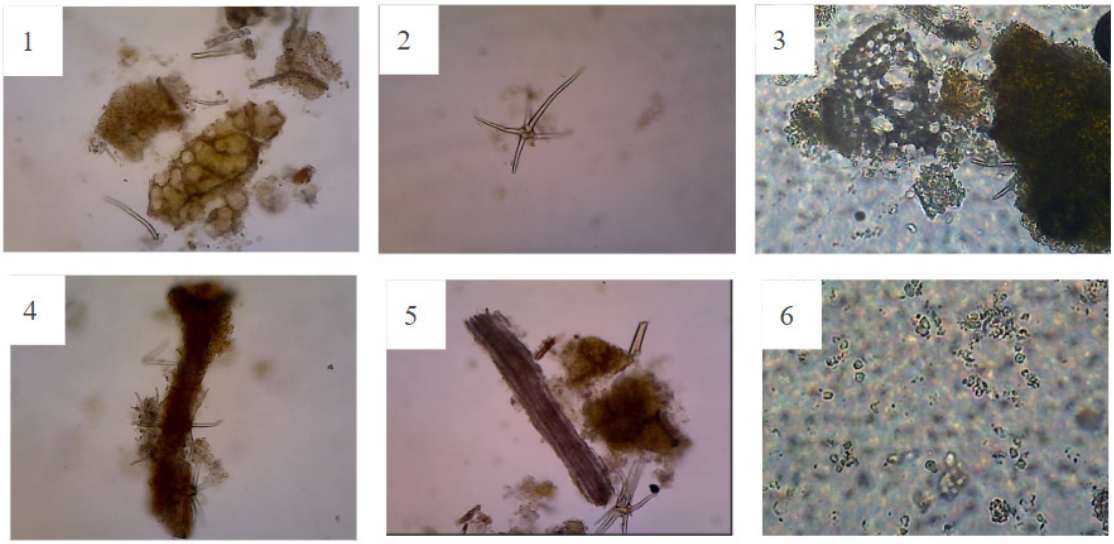

Figure 1. Microscopic observations of *G. ulmifolia* leaf fragments (1: Upper epidermis; 2: multicellular stellate trichomes; 3: lower epidermis with stomata; 4: trichomes attached to leaf veins; 5: vascular tissue; 6: drusen-shaped calcium oxalate crystals.)

the Indonesian Herbal Pharmacopoeia.

3.1.3. Macroscopic

The observation results showed that the samples of *G. ulmifolia* leaf matched the characteristics listed in the Indonesian Herbal Pharmacopoeia. These include a single leaf blade that is oval-shaped with a heart-shaped base, edges that are serrated to coarsely serrated, tips that are pointed to tapering, both surfaces being rough, pinnate leaf veins that stick out on the underside, and a color ranging from brownish green to light brown.

3.1.4. Determination of Water-Soluble and Ethanol-Soluble Extractives Content

Determining the certain-soluble essence content is to provide an initial overview of the quantity of chemical compounds soluble in particular solvents. The average yield of the simplicia extracts soluble in water and ethanol was 14.33% and 3.6%, respectively. The Indonesian Herbal Pharmacopoeia requirements specify that *G. ulmifolia* leaf simplicia must have a water-soluble extract content of at least 9.1% and an ethanol-soluble extract of at least 3.2%. Therefore, the *G. ulmifolia* leaf simplicia meets both minimum requirements.

3.2. Characterization of Non-Specific Parameters of *G. ulmifolia* Leaf

3.2.1. Moisture Content

From triplicate testing of the extract samples, water contents were obtained at 2.71%, 2.84%, and 2.70%. The Indonesian Herbal Pharmacopoeia (HBMP) requirements state that the water content of *G. ulmifolia* leaf extract should not exceed 17.7%. Therefore, the leaf extract meets the maximum water content requirements.[12]

3.2.2. Total Ash and Acid-Insoluble Ash Content

The purpose of determining the total ash and acid-insoluble ash content is to give an overview of the internal and external mineral content that comes from the initial process to the extract's formation.[13] Table 1 presents the results of the total ash and acid-insoluble ash content analysis of *G. ulmifolia* leaf in both simplicia and extract forms, expressed in percentage (% w/w). These results indicate that while the acid-insoluble ash content of the extract meets safety standards, both the total ash and acid-insoluble ash contents of the simplicia and total ash of the extract exceed acceptable limits. These results suggest the potential presence of inorganic impurities or contaminants in the raw material. The higher the ash content, the higher the mineral content in the material. These minerals can be organic salts (e.g., malic acid, oxalate, pectate), inorganic salts (e.g., phosphates, carbonates, chlorides, sulphates, nitrates, and alkali metals), or minerals that form complex organic compounds, and the presence of low acid-insoluble ash content indicating the presence of sand or other impurities.[14]

3.2.3. Heavy Metal Contamination Levels

Heavy metals are defined as any metallic chemical element having a relatively high density and low levels of toxicity or poison, such as Mercury (Hg), Cadmium (Cd), and Lead (Pb). Heavy metals like Hg, Cd, and Pb are part of the first hazardous category. Heavy metals occur naturally in the Earth's crust and are present in varying amounts throughout all ecosystems.[15]

Heavy metal absorption and accumulation in plant tissues are influenced by temperature, moisture, organic matter, pH,

Table 1. Total Ash and Acid-Insoluble Ash Content of *G. ulmifolia* leaf

Parameters	Results (%)		Acceptance criteria	
	Simplicia	Extract	Simplicia	Extract
Total ash content (w/w)	10,61	12,20	≤ 9,1	≤ 8,6
Acid-insoluble ash content (w/w)	4,16	≤0,001	≤ 2,2	≤ 0,4

Table 2. Metal contamination levels of *G. ulmifolia* leaf

No	Parameters	Concentration		Units	Acceptance criteria
		Simplicia	Extract		
1	Pb	≤0,001	0,1986	mg/kg	≤ 10 mg/kg
2	Cd	≤ 0,001	≤ 0,001	mg/kg	≤ 0,3 mg/kg
3	Hg	≤ 0,001	≤ *0,001*	µg/kg	≤ 0,5 mg/kg

and nutrient availability.[16] Different plant species also impact the accumulation of heavy metals, while the ability of plants to absorb metals is determined by either their uptake or the transfer factors of the metals from the soil to the plant.[17] The levels of heavy metal contamination in simplicia and extracts from *G. ulmifolia* leaves were determined using atomic absorption spectroscopy. Table 2 presents data on metal contamination levels in the leaves of *G. ulmifolia*, specifically in both simplicia and extract forms. All measured concentrations fall within the acceptable limits, indicating that the metal contamination levels in the simplicia and extract of *G. ulmifolia* leaf comply with safety standards.

3.3. Phytochemical Analysis

The chemical constituents of plants can be used to assess their various biological activities. Phytochemical screening revealed the presence of flavonoids, phenols, coumarins, saponins, monoterpenoids, and sesquiterpenoids in *G. ulmifolia*. In contrast, tannins, alkaloids, quinones, triterpenoids, and steroids were absent in the sample, as shown in Table 3.

3.4. Thin Layer Chromatography

The positive flavonoid results from the phytochemical screening were verified using the TLC test method. The TLC test used a mix of chloroform, acetone, and formic acid with a ratio of 7:3:1 as the developing solvent and quercetin as the flavonoid standard. Table 4 displays the results of the TLC test. The spots emerged after being sprayed with citroborate, confirming the presence of flavonoids in the leaf extract of *G. ulmifolia*.

3.5. Total Phenolic Content

Phenolic compounds are secondary metabolites that contain at least two hydroxyl groups and one or more aromatic rings.

Table 3. Phytochemical Analysis of *G. ulmifolia* Leaf

Phytochemical Constituents	Simplicia	Extract
Flavonoids	+	+
Phenolics	+	+
Tannins	-	-
Alkaloids	-	-
Saponins	+	+
Quinones	-	-
Coumarins	+	+
Monoterpenoids/Sesquiterpenoids	+	+
Triterpenoids/Steroids	-	-

Table 4. Thin Layer Chromatography Result of *G. ulmifolia* leaf extract

Sample	Rf	Visible Light		UV 254		UV 366		Concl.
		-reagent	+reagent	-reagent	+reagent	-reagent	+reagent	
Standard	0.5	-	yellow	-	blue	-	blue	+
R1	0.5	-	yellow	-	blue	-	blue	+
R2	0.5	-	yellow	-	blue	-	blue	+
R3	0.5	-	*yellow*	-	blue	-	blue	+

These compounds are synthesized through the pentose phosphate, shikimic acid, and phenylpropanoid pathways within plant secondary metabolism. Phenolic compounds may exist either in a free state or bound to other molecules, such as sugars and acids.[19]

The total phenolic content of the extract was determined using the Folin–Ciocalteu method, which is widely recognized as a standard procedure for quantifying phenolic compounds in various food and biological samples due to its simplicity and reproducibility.[20] This method is based on electron transfer reactions, where antioxidant species act as electron donors and the Folin–Ciocalteu reagent serves as an oxidant. The reduction of the phosphotungstic and phosphomolybdic acid complexes by antioxidants results in a color change from yellow to blue, with the intensity of the color being directly proportional to the reducing capacity of the phenolic compounds. The blue complex formed is measured spectrophotometrically at approximately 760 nm.[21]

In this study, the extract reacted with the Folin–Ciocalteu reagent in an alkaline medium, forming a blue-colored solution due to the formation of a phosphomolybdic–phosphotungstic–phenol complex. The regression equation of the calibration curve ($R^2 = 0.998$, $y = 0.0091x + 0.0062$) was used to determine the phenolic content, which was expressed as gallic acid equivalents (GAE) in milligrams per gram of extract (mg GAE/g extract). The total phenolic content of the samples was 2.1 ± 0.297 mg GAE/g extract.

3.6. Total Flavonoid Content

Flavonoids are secondary plant metabolites with a polyphenolic structure. They are among the most common families of natural products found in fruits and vegetables, existing as aglycones, glycosides, and methylated derivatives. Flavonoids comprise several major groups, including anthocyanins, flavonols, flavan-3-ols, flavanones, flavones, and isoflavones.[23]

The total flavonoid content was measured using the aluminium chloride ($AlCl_3$) colorimetric method. This technique is based on the reaction of $AlCl_3$ with the C-4 keto group and the C-3 or C-5 hydroxyl groups of flavones and flavonols to form acid-stable complexes, which are detected spectrophotometrically24. The regression equation of the calibration curve ($R^2 = 0.999$, $y = 0.0028x - 0.0034$) was used to determine the flavonoid content, which was expressed as quercetin equivalents (QE) in milligrams per gram of extract (mg QE/g extract). The total flavonoid content of the samples was 1.27 ± 0.12 mg QE/g extract.

4. Conclusion

The pharmacognostic and phytochemical evaluation of *Guazuma ulmifolia* Lam. leaves confirms their potential as a reliable and standardized source of medicinal plant material. The presence of secondary metabolites such as flavonoids, phenolics, saponins, coumarins, and terpenoids supports the plant's traditional therapeutic applications. The extract complies with the required standards for water- and ethanol-soluble extractive content, moisture content, and heavy metal contamination levels, ensuring its safety

and quality. However, the elevated total ash content observed in the simplicia and extract indicates the need for further improvement in raw material handling and processing.

References

1. Rozqie R, Diah M and Rukmi W. The effect of Jati Belanda (Guazuma ulmifolia Lamk) leaves extract on histopathology of rat's kidney. J Trop Med. 2012;2(1);4316.
2. Al Muqarrabun LMR and Ahmat N. Medicinal uses, phytochemistry and pharmacology of family Sterculiaceae: A review. Eur J Med Chem. 2015;92:514–530.
3. Pereira GA, Araujo NMP, Arruda HS, Farias DP, Molina G and Pastore GM. Phytochemicals and biological activities of mutamba (Guazuma ulmifolia Lam.): A review. Food Res Int. 2019;126:108713.
4. Morais SM, Calixto-Júnior JT, Ribeiro LM, Sousa HA, Silva AAS, Figueiredo FG, Matias EFF, Boligon AA, Athayde ML, Morais-Braga MFB and Coutinho HDM. Phenolic composition and antioxidant, anticholinesterase and antibiotic-modulating antifungal activities of Guazuma ulmifolia Lam. (Malvaceae) ethanol extract. S Afr J Bot. 2017;110:251–257.
5. Chanda S. Importance of pharmacognostic study of medicinal plants: An overview. Pharmacogn Phytochem. 2014;2(5):69-73
6. Elmer P. Analytical Methods for Atomic Absorption Spectroscopy. Norkwalk(CT): The Perkin-Elmer Corporation; 1996.
7. Kancherla N, Dhakshinamoothi A, Chitra K and Komaram RB. Preliminary analysis of phytoconstituents and evaluation of anthelminthic property of Cayratia auriculata (in vitro). Maedica. 2019;14(4):350.
8. Krishna KN, Krishnamoorthy K, Veeraraghavan VP and Jayaraman S. Phytochemical screening and anti-inflammatory and anti-oxidant activities of Spermacoce hispida ethanolic extract. J Pharm Bioallied Sci. 2024;16(2):S1312–S1316.
9. Rahimah SB, Djunaedi DD, Soeroto AY and Bisri T. The phytochemical screening, total phenolic contents and antioxidant activities in vitro of white oyster mushroom (Pleurotus ostreatus) preparations. Open Access Maced J Med Sci. 2019;7(15):2404.
10. Zohra SF, Meriem B, Samira S and Muneer MA. Phytochemical screening and identification of some compounds from mallow. JNPR. 2012;2(4):512–516.
11. Shaikh JR and Patil M. Qualitative tests for preliminary phytochemical screening: An overview. Int J Chem Stu. 2020;8(2):603–608.
12. Badan Pengawas Obat dan Makanan Republik Indonesia. Farmakope Herbal Indonesia Edisi ke-2. Jakarta: BPOM;2017.
13. Departemen Kesehatan RI. Parameter Standar Umum Ekstrak Tumbuhan Obat Cetakan Pertama. Jakarta: Direktorat Pengawasan Obat Tradisional; 2000.
14. Risa S, Nurul F and Yenni EP. Karakterisasi Spesifik Dan Non Spesifik Ekstrak Etanol Daun Putat (Planchonia valida). Al Ulum Sains dan Teknologi 2019;5(1):6-12.
15. Ojovan MI and Lee WE. An Introduction to Nuclear Waste Immobilisation. Amsterdam: Elsevier Science; 2005.
16. Tangahu BV, Abdullah SRS, Basri H, Idris M, Anuar N and Mukhlisin M. A review on heavy metals (As, Pb, and Hg) uptake by plants through phytoremediation. Int J Chem Eng.2011;1:939161.
17. Khan S, Cao Q, Zheng YM, Huang YZ and Zhu YG. Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China. Environ Pollut. 2008;152(3):686–692.
18. Jabeen S, Ali MF, Mohi ud Din A, Javed T, Mohammed NS, Chaudhari SK, Javed MA, Ali B, Zhang L and Rahimi M. Phytochemical screening and allelopathic potential of phytoextracts of three invasive grass species. Sci Rep. 2023;13(1):8080.
19. de Araújo FF, de Paulo Farias D, Neri-Numa IA and Pastore GM. Polyphenols and their applications: An approach in food chemistry and innovation potential. Food Chem. 2021;338:127535.
20. Dominguez-López I, Pérez M and

Lamuela-Raventós RM. Total (poly)phenol analysis by the Folin–Ciocalteu assay as an anti-inflammatory biomarker in biological samples. Crit Rev Food Sci Nutr. 2024;64(27):10048-10054.
21. Pérez M, Dominguez-López I and Lamuela-Raventós RM. The chemistry behind the Folin–Ciocalteu method for the estimation of (poly)phenol content in food: Total phenolic intake in a Mediterranean dietary pattern. J Agric Food Chem. 2023;71(46):17543–17553.
22. Panche AN, Diwan AD and Chandra SR. Flavonoids: an overview. J Nutri Sci, 2016;5:e47.
23. Zawawi N, Chong PJ, Mohd Tom NN, Saiful Anuar NS, Mohammad SM, Ismail N and Jusoh AZ. Establishing relationship between vitamins, total phenolic and total flavonoid content and antioxidant activities in various honey types. Molecules. 2021;26(15):p.4399.
24. Ahmed F and Iqbal M. Antioxidant activity of Ricinus communis. Org Med Chem Int J. 2018;5(4):107–112.