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Pharmacological Benefits Extracts of Putri Malu (*Mimosa pudica* Linn.) in Herbal Medicine: A Review

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Abstract: Herbal medicine has a long history of use as an alternative therapy, especially for acute and chronic diseases. There have been many studies on the Putri Malu plant (*Mimosa pudica* Linn.) to uncover its pharmacological activities. This review paper aims to examine the secondary metabolites present in the extracts of the plant putri malu (*Mimosa pudica* Linn.) and their potential pharmacological actions. The method used was a Systematic Literature Review (SLR), which collected publications from PubMed, ScienceDirect, and Google Scholar databases. From this process, 15 studies were identified that met the predetermined inclusion criteria. Most of the studies used extracts of the leaves putri malu (*Mimosa pudica* Linn.) with ethanol solvent as the leading choice for extraction. The pharmacological activities found include antioxidant (20%), anti-inflammatory, anticancer, and antidiabetic (13.3% each) and contain antibacterial, anticonvulsant, antihelminthic, diuretic, hepatoprotective, antimalarial, antidepressant, and antihyperlipidemic (6.7% each). In conclusion, extracts of the plant putri malu (*Mimosa pudica* Linn.) show great potential for use in herbal medicine. Its wide range of pharmacological actions backs its advantages in treating and preventing several illnesses.

Keywords: Herbal Medicine; *Mimosa Pudica* Linn, Pharmacological Activity.

Introduction

Herbal medicine is a preparation derived from plants and has been used for generations for treatment. Herbal medicine as an alternative treatment continues to grow rapidly and has been applied in various chronic and acute conditions [1]. In 2013, the World Health Organization (WHO) reported that about 65% of people in developed countries and 80% of people in developing countries have used herbal medicine as a form of treatment [2]. Non-communicable diseases (NCDs) had a higher prevalence in 2018, according to Basic Health Research (Riskesdas) results, than in 2013 statistics. The incidence of cancer rose from 1.4% to 1.8% in 2018, while the prevalence of diabetes mellitus rose from 6.9% to 8.5%. These two diseases are examples of non-communicable diseases (NCDs) that increased in 2018 [3]. Also, neurological and cardiovascular disorders, among others, have oxidative stress as one of their primary causes [4].

In natural chemistry, phytochemicals refer to secondary metabolites produced by plants, which act as protection and defence mechanisms because they are generally toxic to animals. The secondary metabolites contained in these plants can be used as herbal medicines [5,6]. Secondary metabolites often found in plants include alkaloids, flavonoids, tannins, saponins, terpenoids, and glycosides [7]. Antibacterial, anti-inflammatory, analgesic, local anaesthetic and anticancer are only a few of the many pharmacological actions of alkaloids. Today, alkaloids generally derived from plants are still the focus of research in the fields of organic chemistry, biology, biochemistry, pharmacology, and pharmacy, with well-known examples such as morphine, strikingnum, quinine, atropine, caffeine, ephedrine, and nicotine [8]. Various classes of flavonoids have been isolated and exhibited several significant pharmacological activities, including anticancer, antibacterial, antifungal, antidiabetic, antimalarial, neuroprotective, cardioprotective, and anti-inflammatory activities [9]. Tannins have long been known for their various health benefits; new studies have shown that they may fight cancer, inflammation, microbes, and oxidative stress and even protect against cardiovascular disease, neurological disorders, and metabolic syndrome [10]. Fungicidal, antibacterial, antiviral, anti-inflammatory, anticancer, antioxidant, and immunomodulatory effects have been associated with saponins and other secondary metabolites [11]. The range of pharmacological effects terpenoids exhibit includes protection against cancer, inflammation, infection, pain, viruses, and parasites [12].

The putri malu plant (*Mimosa pudica* Linn.) has been used to prevent and treat various diseases [13]. Various parts of the putri malu plant have broad pharmacological activities, including antioxidant, antibacterial, antifungal, anti-inflammatory, hepatoprotective, anticonvulsant, antidepressant, diuretic, antiparasitic, and antimalarial. The putri malu plant is known for several critical secondary metabolites it has, such as alkaloids, mimosine, tannins, steroids, flavonoids, triterpenes, and glycosyl flavones [14].

The plant putri malu (*Mimosa pudica* Linn.) was chosen as the focus of the review article due to its proven effectiveness in addressing liver damage, inflammation, and anxiety, as well as its potential to address modern health concerns. Epidemiological data shows the need for effective treatments for liver disease, which is becoming a common problem worldwide. For example, liver disease causes about

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2 million deaths annually, so effective hepatoprotective agents are needed [15,16].

Based on the explanation above, this review article aims to examine the pharmacological activity of putri malu plant extracts (*Mimosa pudica* Linn.) as herbal medicine. It is hoped that this study can provide comprehensive data for putri malu plant research (*Mimosa pudica* Linn.), especially regarding pharmacology.

Research Methods

The method used in this review article is Systematic Literature Review (SLR). Publish or Perish, article identification, article screening, and possible article selection are all steps in the Systematic Literature Review (SLR) methodology employed in this review article. Pubmed, Science Direct and Google Scholar were the sources used to gather articles from 2014 to 2024 to meet the most recent findings. The keywords used to perform the literature search were Mimosa pudica Linn. extract, the pharmacological effects of *Mimosa pudica* Linn., potential *Mimosa pudica* Linn., and herbal medicine. The previously established inclusion and exclusion criteria were used to select the articles considered for inclusion. Table 1 displays the criteria used to include or exclude studies from this literature. Population, Intervention, Control, and Outcome (PICO) is the framework for creating inclusion criteria. Table 2 displays the PICO framework used in this research.

Table 1. Inclusion and Exclusion Criteria

No.	Inclusion Criteria	Exclusion Criteria
1.	Information gathered from research publications is utilized in the study.	Research that uses data other than the results of research articles.
2.	Research that discusses the potential of Putri Malu plant extract (*Mimosa pudica* Linn.) in herbal medicine as the main study.	Research on the potential of Putri Malu plant extracts (*Mimosa pudica* Linn.) in herbal medicine is not the main study.
3.	Year of issue between 2014 to 2024.	Year of issue outside the range of 2014 to 2024.
4.	The language used in the article is English and Indonesian.	The language used in the article is other than English and Indonesian.

Table 2. PICO Framework

P (Population)	An herbal remedy based on the extract of the Putri Malu plant (*Mimosa pudica* Linn).
I (Intervention)	Extract of the Putri Malu Plant (*Mimosa pudica* Linn).
C (Comparison)	Validation of the method using conventional medicine.
O (Outcome)	Putri Malu Plant Extract's (*Mimosa pudica* Linn.) efficacy in the in vitro and in vivo therapy of many disorders.

After being first selected based on the inclusion and exclusion criteria, the articles were evaluated using a prism flow diagram. Figure 1 illustrates the prism design used to choose the articles.

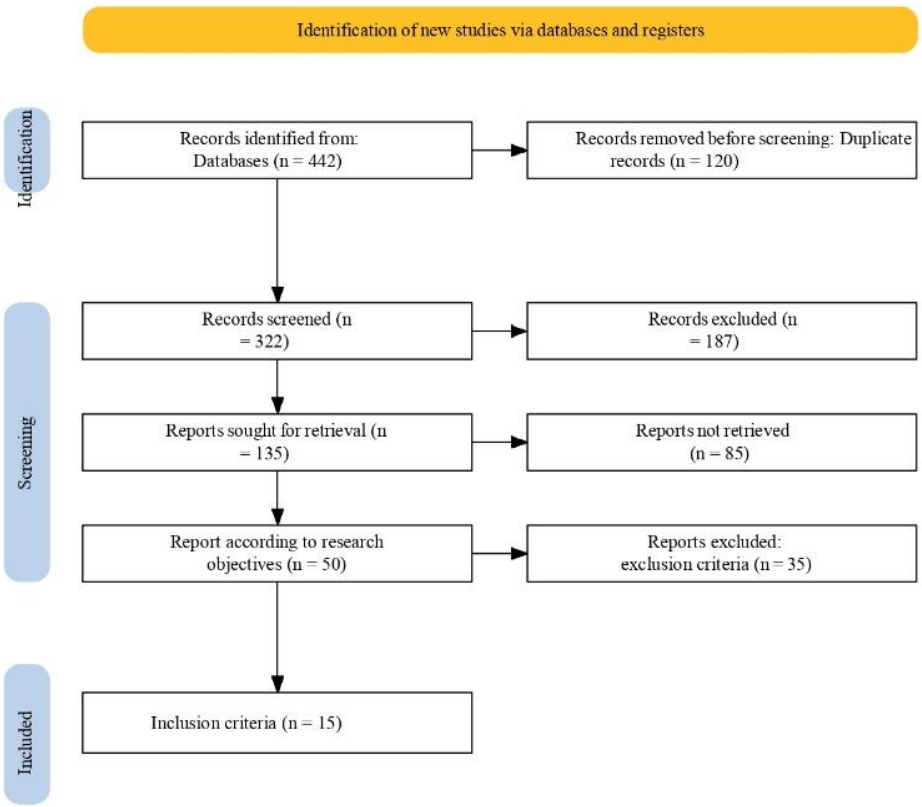

Figure 1. PRISMA Flow Diagram [17]

Results and Discussion

Table 3. Pharmacological Activity of Putri Malu Plant Extract (*Mimosa pudica* Linn.)

Reference	Sample	Pharmacologic Activity	Research Results
(Arfiandi et al., 2022)	Leaf Ethanol Extract	Anti-inflammatory	At 500 mg/kgBB and 1000 mg/kgBB doses, it demonstrates anti-inflammatory action by reducing the average volume of edema [18].
(Azam et al., 2015)	Leaf Ethanol Extract	Anti-inflammatory	At a dosage of 300 mg/kg, it reduced paw swelling by 50% after 1 hour and reached a maximal inhibition of 43.48% after 4 hours, with an IC50 of 24.55 µg/ml [19].
(Mondol & Islam, 2022)	Ethyl Acetate Extract of Leaves, Stems, and Roots	Antioxidants	Exhibited antioxidant activity at IC50 values of 65.152µg/ml, 76.036µg/ml, and 65.000µg/ml, respectively [20].
(Adhityasmara et al.,2022)	Leaf Ethanol Extract	Antioxidants	The IC50 value was 352.46 µg/ml, indicating that it has antioxidant properties [21].
(Parmar et al., 2015)	Ethanol Extracts of Stems, Leaves, Roots, and Flower Buds	Antioxidant and Anticancer	The antioxidant activity was demonstrated with an IC50 value of 103.88 µg/ml. After 72 hours, the *Mimosa pudica* Linn. extract exhibited anticancer activity with an IC50 of 201.65 µg/ml [22].
(Chandra et al., 2020)	Water Extract, Ethanol Extract, and Chloroform Extract of Leaves.	Anticancer	The aqueous extract has an IC50 of 71.32 µg/ml, ethanol extract of 90.33 µg/ml, and chloroform extract of 1190.69 µg/ml indicating *Mimosa pudica* Linn. has cytotoxic activity, and the potential to kill neoplastic cells [23].
(Mandal et al., 2022)	Leaf Ethyl Acetate Extract.	Antibacterial	It demonstrated antibacterial action against Gram-positive bacteria at a dosage of 200 mg/mL extract. The inhibition zones for *Staphylococcus aureus*, *Escherichia coli*, and *Klebsiella pneumonia* are 15 mm, 17 mm, and 16 mm, respectively, when tested against Gram-negative bacteria [24].
(Alasyam et al., 2014)	Leaf Ethanol Extract	Anticonvulsants	Demonstrated a highly significant ($p<0.000$) decrease in tonic extensor phase duration as well as maximum inhibition (80% mortality) of MES-induced seizures at a dose of 200mg/kg [25].
(Velmurugan et al.,2024)	Leaf Acetone Extract	Antihelminthic	The paralysis time of worms at concentrations of 5, 10, 15, and 20mg/ml were 15, 10, 8, and 5 seconds, respectively, and the death time was 8, 7, 5, and 3 seconds [26].
(Kalabharathi et al.,2015)	Ethanol Root Extract	Diuretics	Doses of 100 and 200 mg/kg significantly increased urine volume and sodium (Na+), potassium (K+), and chloride (Cl-) clearance, demonstrating its diuretic effect [27].
(Paras et al., 2022)	Leaf Ethanol Extract	Hepatoprotective	The increased levels of bilirubin, cholesterol, albumin, alkaline phosphate, A/G ratio, urea, and creatinine were significantly reduced at a dosage of 500 mg/kg [28].
(Amilah & Fitria, 2015)	Leaf Ethanol Extract	Antimalarials	Showed mortality of *Aedes aegypti* and *Anopheles* mosquito larvae at lethal concentrations of 3.25 and 1.88 g/l water, respectively [29].
(Patro et al., 2016)	Leaf Ethyl Acetate Extract	Antidepressants	Showed dopamine and norepinephrine concentrations increased significantly after 4 weeks of treatment [30].
(Wahjuni et al., 2021)	Leaf Ethanol Extract	Antidiabetes	Tests on rats with hyperglycemia reveal that 150 mg/kg BW reduces blood glucose and malondialdehyde levels [31].
(Parasuraman et al., 2019)	Leaf Methanol Extract	Antidiabetic and Antihyperlipidemic	Rats werw given glibenclamide with a methanolic extract of *Mimosa pudica* Linn. had significantly lower levels of glucose, TG, LDL, and VLDL [32].

The results show that the leaves were the most important element of the putri malu plant (*Mimosa pudica* Linn.) utilised in the study, based on the investigation of the pharmacological activity of the extract, with a percentage reaching 93.3%, followed by the roots with a percentage of 20%. In addition to leaves and roots, the stem has a percentage of 13.3%, while flower buds were used in only 6.7% of studies. Due to their high concentration of secondary metabolites, which include a wide range of polyphenolic chemicals including alkaloids, flavonoids, terpenoids, sterols, tannins, and saponins, putri malu leaves (*Mimosa pudica* Linn.) are frequently utilised in studies investigating the pharmacological activities of plants [21].

Compounds in putri malu (*Mimosa pudica* Linn.) are often the subject of pharmacological research due to their potential therapeutic benefits. Studies show that the methanol extract of putri malu (*Mimosa pudica* Linn.) has significant antidiabetic and antihyperlipidemic effects, which are influenced by its bioactive compounds that play a role in various pharmacological mechanisms, including antioxidant activity and modulation of insulin signalling pathways [32]. The antioxidant activity of M. pudica, supported by its polyphenol content, has been widely studied. The high content of such phenolic compounds contributes to their potent antioxidant activity, which is essential in addressing oxidative stress-related diseases [33].

In terms of solvents used for extraction, ethanol solvent dominates with 66.7%, followed by ethyl acetate with a percentage of 20%. The fact that all secondary metabolites can be successfully taken out of putri malu plants (*Mimosa pudica* Linn.) using ethanol as a solvent demonstrates how commonly this solvent is used [31].

Pharmacological Activity Testing *In Vitro* Method

In pharmacological activity testing, in vitro methods were used by 33.3% of studies to identify antioxidant, anticancer, and antibacterial activities of extracts of the putri malu plant (*Mimosa pudica* Linn.). In vitro testing generally involves cells or tissues under laboratory conditions to understand the specific mechanisms of bioactive compounds. Antioxidant activity is often assessed by researchers using the DPPH free radical capture test technique [20–22]. While the MTT assay technique was used to test for anticancer activities in the study [22,23], Utilising Mueller Hinton agar (MHA) medium, the agar well diffusion technique was used to assess antibacterial activity [24].

Pharmacological Activity Testing In Vivo Method

Research evaluating the pharmacological action of putri malu plant extracts (*Mimosa pudica* Linn.) also utilised in vivo techniques, which include living creatures, in another 66.6% of the research. In vivo testing allows researchers to monitor pharmacological activity directly on organisms such as test animals. For example, the antimalarial activity of putri malu (*Mimosa pudica* Linn.) plant extracts can be tested on mosquito larvae [29], while antihelminthic activity can be tested using animals such as worms [26]. Animals such as rats and mice are often used in research to evaluate the pharmacological activities of anti-inflammatory, anticonvulsant, antihelminthic, diuretic, hepatoprotective, antidiabetic, antidepressant, and antihyperlipidemic. To this day, valuable information on disease processes and possible therapeutic targets may be gleaned from studies conducted on mice [34].

The Role of Secondary Metabolites on the Pharmacological Activity of Putri Malu Plant Extract (*Mimosa pudica* Linn.)

The putri malu plant extract's (*Mimosa pudica* Linn.) pharmacological action is dominated by antioxidant activity, which accounts for 20% of the total pharmacological action. Other activities include anti-inflammatory, anticancer, and antidiabetic activities, each with the same percentage of 13.3%. Additional pharmacological activities that were also studied, although with a lower percentage (6.7% each), included antibacterial, anticonvulsant, antihelminthic, diuretic, hepatoprotective, antimalarial, antidepressant, and antihyperlipidemic.

Phytochemical components found in Putri Malu (*Mimosa pudica* Linn.) leaves, including flavonoids, are responsible for the anti-inflammatory action of the plant's extract. A key component of prostaglandin formation, the cyclooxygenase pathway is inhibited by flavonoids [18].

Extracts from the leaves stems, and roots of putri malu (*Mimosa pudica* Linn.) contain flavonoids, a kind of secondary metabolite that may have antioxidant properties. Anions of superoxide, hydroxyl radicals, and lipid peroxy radicals can all be neutralised by flavonoid antioxidants [19].

Due to its antioxidant secondary metabolites, including alkaloids, flavonoids, terpenoids, saponins, and coumarins, Putri malu leaf extract (*Mimosa pudica* Linn.) may also have antihyperglycemic effects. By blocking the oxidation process, which can harm pancreatic cells, these chemicals can help lower blood glucose levels [31]. Furthermore, by inhibiting oxidative stress, the combined effects of these secondary metabolites help mitigate the consequences of type 2 diabetes mellitus [20].

According to reports, the alkaloid L-mimosine, found in the root extract of putri malu (*Mimosa pudica* Linn.), is responsible for the plant's diuretic action and may indirectly produce pressure natriuresis [27]. The anticancer effect of the putri malu plant extract (*Mimosa pudica* Linn.) is exhibited by flavonoid, alkaloid, and triterpenoid components. These chemicals block the division mechanism and activate the cancer cell death pathway [35].

Oxidative stress is one of the early indicators that contribute to the development of seizures and cytotoxicity in epileptic situations. With its powerful antioxidant capabilities, the Putri malu leaf extract (*Mimosa pudica* Linn.) may restore oxidative equilibrium, making it an effective anticonvulsant medication. It would do this by reducing the frequency and severity of epileptic convulsions and protecting neurons from cytotoxic damage [25].

Some research suggests that alkaloid chemicals have an antihelminthic impact by paralysing the parasites' central nervous systems, leading to their demise [26]. Putri Malu (*Mimosa pudica* Linn.) leaf extract contains glycosides and flavonol glycone class chemicals, which can prevent a variety of illnesses, as well as have significant antioxidant activity and hepatoprotective benefits [28].

The antidepressant action of putri malu (*Mimosa pudica* Linn.) leaf extract in the tail suspension test is believed to be due, in part, to its activation of dopamine D1 and D2 receptors. It is quite probable that the antidepressant

effect is because EAMPs activate the dopaminergic system [30].

Aedes aegypti and *Anopheles* mosquito larvae are poisoned by the alkaloids, saponins, and flavonoids found in putri malu (*Mimosa pudica* Linn.) leaf extract, which is used as a stomach poison. These chemicals go into the larvae's digestive system when they eat the leaves' ethanol extract. After entering the larva's bloodstream via the intestinal wall, the larvicide works through the larva's circulatory system to lower the energy needs by interfering with metabolic activities. As a result, the larvae have convulsions and eventually die [29].

Conclusion

There is pharmacological promise in extracts from the putri malu plant (*Mimosa pudica* Linn.), with the leaves being the most widely utilised part owing to their high concentration of secondary metabolites. When extracting active chemicals, ethanol is the solvent of choice. The pharmacological activities of this compound include a wide range of actions against inflammation, cancer, bacteria, seizures, helminths, the liver, depression, diabetes, and high cholesterol. Its active ingredients include secondary metabolites of flavonoids, alkaloids, terpenoids, saponins, coumarins, glycosides, and flavonol glycones. Further research on putri malu (*Mimosa pudica* Linn.) is recommended to include clinical trials to ensure its safety and effectiveness in humans, as well as deepen the understanding of the mechanism of action of its active compounds. In addition, developing innovative herbal formulations, such as nano-herbals, and long-term toxicity evaluation are essential aspects that can be the focus of future research.

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