The Performance of Bioactive Compounds in The Putri Malu Plant (*Mimosa Pudica* Linn*)* as an Alternative Plant for Diabetes Medication

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Abstract. There are around 30,000 types of plants in Indonesia, of which around 7,000 can be used as medicine. One medicinal plant with many benefits is the shy princess plant (*Mimosa pudica* Linn), which comes from *the Mimosaceae family*. This plant contains a group of secondary metabolites rich in phenols, alkaloids, flavonoids, saponins, terpenoids, tannins, and coumarins. The Putri malu plant is used in the pharmacological field as an anti-diabetic, antioxidant, anti-depressant, anti-hyperlipidemic, anti-inflammatory, anti-hyperuricemic, and healing burns. Information about this plant is still limited, so this research is essential. This research uses a literature study method *for* data collection. This research aims to obtain information on how putrimalu can be used as an alternative treatment for diabetes and its bioactivity.

Keywords: Bioactivity**,** Diabetes, Literatur study, *Mimosa Pudica* Linn, Putri malu

INTRODUCTION

Indonesia is a tropical country with a lot of biodiversity. Around 30,000 types of plants in Indonesia, and around 7,000 of them can be used as medicine; however, only around 20% are known and used (Siahaan & Aryastami, 2018). According to Komala Lukiati *et al*., (2016) Biopharmaceutical development in Indonesia still needs to be improved. This is caused by a lack of public knowledge about the benefits and how to use medicinal plants. People generally need more knowledge about herbal medicines and how to use them. Currently, phytopharmaceuticals registered by the Food and Drug Supervisory Agency (BPOM) are still limited, and most come from research by individuals or industry, not government programs (Siahaan & Aryastami, 2018).

Many studies have been carried out to dig deeper into the benefits of medicinal plants in Indonesia. One of them is research on the embarrassed princess (*Mimosa pudica* Linn), a plant from *the Mimosaceae family*. This plant has long been believed to be a traditional treatment for various diseases such as urogenital disorders, dysentery, hemorrhoids, diabetes, sinus, and wound healing, as an antidepressant, anticonvulsant, antifertility, antimicrobial, antifungal, antiviral, and has hypoglycemic and diuretic effects (Ahmad, Sehgal, et al., 2012).

According to Mustapa et al., (2017)the plant (*Mimosa pudica* Linn) lowers blood glucose levels in Diabetes Mellitus sufferers. Diabetes Mellitus (DM) is a chronic disease characterized by high glucose levels in the blood, where the blood sugar level reaches 200 mg/dl or more, and the fasting blood sugar level exceeds or is equal to 126 mg/dl. This disease is often referred to as a silent killer because sufferers usually don't realize it, and complications are only detected after they occur (Hestiana Dita Wahyu, 2017).

According to the International Diabetes Federation report, in 2022, there will be around 537 million adults (aged 20-79 years) who have diabetes worldwide. This figure is expected to increase to 643 million in 2030 and reach 784 million in 2045. Diabetes mellitus causes around 6.7 million deaths in 2021. About 44% of adults who have diabetes, around 240 million people, have not yet been diagnosed. Additionally, there are approximately 541 million adults worldwide who have impaired glucose tolerance, increasing their risk of developing type 2 diabetes mellitus (IDF, 2021).

Treatment therapy given to diabetes mellitus sufferers is often unsuccessful because they feel bored with procedures that have to be carried out repeatedly. This therapy usually involves non-pharmacological steps such as a strict diet, regular exercise, managing stress, etc. As a result, controlling blood sugar levels in people with type 2 diabetes mellitus is often unsuccessful (Sutomo, 2023). According to Leonita Emy & Muliani Ariska (2015), people with higher education prefer combining medical and traditional medicine rather than relying on medical medicine alone. One plant that could be used as a candidate for anti-diabetic drugs is *Mimosa pudica* Linn.

The Putri Malu plant has bioactive compounds that can be used as medicinal ingredients. Ernawati (2013)stated that the Indonesian government encourages people to use traditional medicine because it has fewer side effects. However, studies on medicinal plants are still limited, especially regarding diabetes and their bioactivity. Therefore, this research is essential to do. This research aims to obtain information to understand better how Putri Malu can be used as an alternative treatment for diabetes and its bioactivity.

MATERIALS AND METHODS

Study area

The method used in this research is literature study *research*. The literature study in this research is a series of activities relating to library data collection methods and managing research data objectively, systematically, and analytically. Data was obtained using online media such as Google and journal sites, as well as national and international journals, using the keywords of the *Mimosa pudica* Linn plant. The data collected and analyzed is secondary data taken from 2010-2023 in the form of research results such as books, journals, articles, internet sites, and others relevant to using the Putri Malu plant as an alternative medicinal plant for diabetes mellitus and its bioactivity.

Table 1. Secondary data used

Data analysis

Name	Publication Title	Journal	Year	Amount
Mehingko , L., Awaloei , H., & Wowor , M. P	*Mimosa pudica Duchaas & Walp)* leaf extract in vitro.	Journal Biomedicine	2010	
Rajendran Rekha, & Krishnakumar Ekambaram	Hypolipidemic Activity of Chloroform Extract of Mimosa pudica Leaves	Avicenna Journal of Medical Biotechnology	2010	2
Azmi, L., Singh, M.K., & Kamal Akhtar, A	International Journal Of Pharmacy & Life Science Pharmacological and biological overview on *Mimosa pudica* Linn.	Int. J. of Pharm. & Life Sci. (IJPLS)	2 011	1
Saraswat, R., & Pokharkar , R.	GCMS Studies of Mimosa pudica	In International Journal of PharmTech Research CODEN	2012	2
Ahmad, H., Sehgal, S., Mishra, A., & Gupta, R.	*Mimosa pudica* L. (Laajvanti): An Overview	Pharmacognosy Reviews	2012	
Johnson, K., Narasimhan, G., & Krishnan, C.	*Mimosa pudica* Linn-a shyness princess: A review of its plant movement, active constituents, uses and pharmacological activity	International Journal of Pharmaceutical Sciences and Research	2014	1
Leonita Emy, & Muliani Ariska	Related Factors in the Working Area of the Rejosari Pekanbaru Community Health Center in 2015	Journal of Community Health	2015	
Parmar, F., Kushawaha , N., Highland, H., & George, L.-B	In Vitro Antioxidant and Anticancer Activity Of *Mimosa Pudica* Linn Extract and L- Mimosine on Lymphoma Daudi Cells	Original Article.	2015	3
Tunna , TS, Zaidul , ISM, Ahmed, QU, Ghafoor, K., Al- Juhaimi , FY, Uddin, MS, Hasan, M., & Ferdous, S	Analysis and profiling of extract and fractions of neglected weed *Mimosa pudica*	South African Journal of Botany	2015	

Name	Publication Title	Journal	Year	Amount
	Linn. traditionally used in Southeast Asia to treat diabetes			
Komala Lukiati, Hanny Hafiar, & Subekti Priyo	Communication Network in Disseminating Herbal Medicine Information among Users	Journal of Communication Sciences, Faculty of Communication Sciences, BSI University, Bandung	2016	1
Hestiana Dita Wahyu	Factors Associated with Compliance in Diet Management in Type 2 Diabetes Mellitus Outpatients in Semarang City	Journal of Health Education,	2017	
Konsue , A., Picheansoonthon , C., & Talubmook , C.	Fasting blood glucose levels and hematological values in normal and streptozotocin-induced diabetic rats of mimosa pudica L. extracts.	Pharmacognosy Journal	2017	4
Mustapa, K., Rizky Amalia, & Juna Minarni Rama.	*Mimosa pudica Linn)* Plant Extract on Reducing Blood Glucose Levels in Mice (Mus musculus)	Academic Journal of Chemistry	2017	
Tusnava , ST, Qamar, UA, Ghafoor, K., Sahena , F., Jahurul, MHA, Rukshana, AH, Juliana, MJ, Al- Juhaimi , FY, Jalal, LJKCA, Ali, ME, & Zaidl , IS M	A- glucidase Inhibitor Isolated from *Mimosa pudica* L	Natural Products Research	2017	
Siahaan, S., & Aryastami, NK	Study of Medicinal Plant Development Policy in Indonesia	Health Research and Development Media	2018	1
Defi, LR, & Julianto , E	The Effect Of Princess Shame Leaves Ethanol Extract On Vitiligo	In IJBHM (International Journal of Biomedical Herbal Medicine) Int.J.Bio.Herb	2021	
IDF	(IDF Diabetes Atlas, 10th Edition.	In Journal of Experimental Biology.	2021	
Khan, F., Indika Bamunuarachchi, N., Tabassum, N., & Kim, Y.-M	Caffeic Acid and Its Derivatives: Antimicrobial Drugs toward Microbial Pathogens	J Agri Food Chem	2021	5
Septiani , B., Halimah, L., Ruspita , R., Puspitasari , L., Sultan Maulana Hasanuddin Banten Jl Sheikh Nawawi Al Bantani Kp Andamu , N., Sukawana , K., & Curug , K.	Analysis Comparison Morphology of Mimosa pudica L. and Mimosa pigra L. in the Village Susukan , Regency Serang , Banten Comparative Analysis of	Tropical Bioscience: Journal of Biological Science	2021	

Name	Publication Title	Journal	Year	Amount
	Morphology of Mimosa pudica L. and Mimosa pigra L.			
Wahjuni , S., Asih, IARA, Bili, DT, Puspawati, NM, & Fudholi , A	Effect of the Ethanol Extract of Mimosa Leaves on the Blood Glucose, Malondialdehyde, and Histopathological Characteristics of Wistar Rats.	Open Access Macedonian Journal of Medical Sciences	2021	
Bili, D.T	*Pharmacological Effects of the Malu Princess Plant (Mimosa pudica Linn)* .	Beta Chemistry Journal (JBK)	2022	
Singarapriyavardhanan, ST, Shanmugam, PST, Narayana, SKK, Ammari, AA, Amran, RA, & Alhimaidi, AR	*Mimosa pudica* alleviates streptozotocin - induced diabetes, glycemic stress and glutathione depletion in Wistar Albino Rats	Journal of King Saud University-Science	2022	2
Adurosakin , OE, Iweala, EJ, Otike , JO, Dike, ED, Uche, ME, Owanta , JI, Ugbogu , OC, Chinedu, SN, & Ugbogu , EA	Ethnomedicinal uses, phytochemistry, pharmacological activities and toxicological effects of *Mimosa pudica* - A review	Pharmacological Research - Modern Chinese Medicine	2023	
Salma , Rahmah	Relationship Analysis of Fabaceae Family Plants Based on Morphological Characteristics in Jatinangor District, Sumedang Regency	Constants: Journal of Mathematics and Natural Sciences	2023	2
Total				25

RESULTS AND DISCUSSION

3.1 Description and Cultivation of Putri Malu Plants

Mimosa pudica Lin., also commonly called the Mue, is an upright growing shrub with thorny spots and round, pink flower heads. Almost all countries also call this plant a weed (Rajendran Rekha & Krishnakumar Ekambaram, 2010). *Mimosa pudica* Linn is an annual climbing plant. This plant originates from tropical America and is naturalized in almost all tropical and subtropical places. Usually they are in open areas, especially on roadsides, agricultural land, and rubbish bins (Sehgal, et al., 2012).

Classification of *Mimosa pudica* according to Ahmad *et al*., (2012) are as follows:

Kingdom : Plantae
Division : Spermatophyta
Classis : Angiosperms
Order : Rosales
Family : Mimosaceae
Family : Mimosaceae
Genus : Mimosa
Species : *Mimosa pudica* Linn

- Classification picture

(Image of Morphological Characters of Mimosa pudica. A Stem , B= leaf , C= flower , D= fruit)
Source :(Septiani *et al*., 2021)

Morphology *Mimosa pudica*

- Root

Mimosa pudica roots are characterized by a cylindrical, tapered shape with secondary and tertiary branches. The roots have a grayish brown to brown color, rough or elongated wrinkled surface, pale yellow color, and fibrous bark. *Mimosa pudica* also has a distinctive odor and slightly astringent taste (Sehgal et al., 2012).

Image of embarrassed princess roots
Source :(Adurosakin *et al*., 2023)

- Leaf

Mimosa pudica Linn leaves are characterized by their leaves being compound and also having small teeth. Each of these small leaf fins usually has an arrangement of between five and twenty-six leaflets for each leaf fin. The leaves of the Maluku plant have an elongated shape with a rounded base and a pointed tip. The leaves of the mollusk plant are tiny, measuring about 6–16 mm long and 1–3 mm long(Salma, 2023).

Image of a shy princess leaf
Source :(Adurosakin et al., 2023)

- Stem

The stem of *Mimosa pudica* has a cylindrical shape with a diameter of up to 2.5 cm and is covered with long, weakly elongated hairs. The bark is fibrous, separates easily from the wood, and is light brown with a gray internal surface(Ahmad *et al*., 2012).

Picture of a shy princess
Source :(Mehingko *et al*., 2010)

- Flower

Flower *Mimosa pudica* is colored red young, with a round stem and prickly petals that are very small; the corolla is pink and has four lobes, an oval round egg, has 4 stamens, and its ovule Lots (Ahmad *et al*., 2012).

Picture of a shy princess flower
Source :(Johnson *et al*., 2014)

- Seed

Seed plant daughter Embarrassed oval- elliptical with color chocolate until gray, 0–0.3 cm long, 2.5 mm wide, and has a ring center on each surface (Sehgal *et al*., 2012).

Image of shy princess seeds
Source :(Johnson *et al*., 2014)

3.2 Biochemistry of the Malu Princess Plant

The shy princess plant contains a group of secondary metabolites rich in phenols, alkaloids, flavonoids, saponins, terpenoids, tannins, and coumarins. It also has pharmacological activities such as anti-diabetic, antioxidant, antidepressant, anti-hyperlipidemia, anti-inflammatory, anti-hyperuricemia and burn wound healing. The activity of the shy princess plant can be the most widely reported antidiabetic and antioxidant drug (Bili, 2022).

Mimosa Pudica plant can be extracted from its leaves to obtain quercetin-type flavonoid compounds, which have two effects on the body: stimulating the enzymatic activity of RNA and protein through DNA biosynthesis. Several types of flavonoids, especially silymarin, are reported to stimulate the enzymatic activity of RNA and proteins (Defi & Julianto, 2021). According to Tunna *et al*. (2015). Putri Malu (*Mimosa pudica L)* has the highest content of methanol extract (MeOHi) and methanol fraction derivatives as inhibitors of the enzymes α -glucosidase and α -amylase in the inhibition test using GC Q-TOF MS analysis. The function of inhibiting the digestive enzymes α -glucosidase and pancreatic α -amylase is to prevent glucose absorption in the blood and an increase in blood glucose levels.

Several phenolic compounds have been identified in mimosa plants, including catechin, gallic acid, caffeic acid, and chlorogenic acid. Chlorogenic acid is the most common phenolic acid, except for green

coffee and tea. As a pure polyphenol, it has been shown to have various therapeutic properties, including antioxidant, antibacterial, hepatoprotective, and cardioprotective properties (Parmar *et al*., 2015). Gallic acid is a metabolite with anti-inflammatory, antimicrobial, antioxidant, and anticancer properties. Phenolic and acrylic functions are found in caffeic acid, usually called hydroxycinnamic acid. Antibiotics were tested in free, compound, or nanoformulations (Khan *et al*., 2021). In addition, many flavonoids have been identified, namely polyphenols with the structural unit 2-phenylchromone, including the following. They have healing effects against cancer, heart problems, chronic inflammation, and hypoglycemia (Adurosakin *et al*., 2023).

According to Vinothapooshan (2010), the shy princess plant contains phytochemicals, the presence of flavonoids, phytosterols, alkaloids, amino acids, tannins, glycosides, Gum, Tubuline, Phytosterols, and fatty acids detected by phytochemical studies. In the leaf organs, there are substances such as adrenaline, yellow-green fatty oil -17%, terpenoids, coumarin, quinine, derivatives of gallic acid 4- α -(bd-glucopyranosyl6-sulfate), c- glycosyl flavone, phenolic ketone34, jasmonic acid, norepinephrine, d-pinitol (3-mono-methyl ether inositol), sitosterol (Azmi *et al*., 2011). Crocetin dimethyl ester and tannin have been isolated from the plant. The Mimosa pudica Lin plant seeds have a mucus containing D-xylose and D-glucuronic acid 4-O- (3, 5-dihydroxybenzoic acid)-bD-glucuronide. It has four flavones, namely 7,8,3',4'-tetrahydroxyl6-C-[alpha-l-rhamnopyranosyl-(1→2)]-b-Dglucopyranosyl flavone (I); 5,7,4'-trihydroxyl-8-C- [al-rhamnopyranosyl-(1→2)]- D-glucopyranosyl flavone (III) and catcher (IV) as well as the presence of Saponin and bufadienolide (Seghal *et al*., 2012).

Coumaric acid is a common plant constituent, and coumaric acid derivatives act as leaf-opening agents in other nyctinastic plants. C-glycosyl flavones are present in the aerial part. The leaves of *the Mimosa pudica* Linn plant contain beta-sitosterol and phenolic ketones. The oil extract contains amino acids and amino acid derivatives such as N-dl-Alanylglycine, dl-Alanyl-dl- Valine, alanine, dl-alanine ethyl ester, dl-alanyl-dl-valine, and 1-alanine ethyl amide. There is an oil extract with fatty acid derivatives such as 9, 12-Octadecadienoic (Z, Z), methyl ester, 11, 13-Eicosadienoic acid. Other constituents present in the oil extract are methyl ester, 2-methylamino-N- phenylacetamide, 1-octanamine, N-methyl, 1-Butanamine, and N-methyl (Saraswat & Pokharkar, 2012).

3.3 Benefits of the Putri Malu Plant as an Antidiabetic

The leaves of the *Mimosa pudica* plant have antidiabetic activity that can reduce blood glucose levels and malondialdehyde (MDA) levels. This extract can also improve the histopathology of pancreatic β -cells, which are damaged due to oxidative stress induced by increased blood glucose (Wahjuni et al., 2021). Analysis using LCMS/MS (*Liquid Chromatography* with *tandem mass spectrometry*) is an advanced analytical technique that combines the separation power of liquid chromatography with the empathetic and selective mass analysis capabilities of triple quadrupole mass spectrometry. Analysis using LCMS/MS (*Liquid Chromatography* with *tandem mass spectrometry*) identified eight compounds in the ethanol extract of Putri Malu leaves, including luteolin and apigenin, which are thought to play an essential role as antidiabetic agents. In addition, the ethyl acetate fraction from the methanol extract of the putrimalu plant contains bioactive compounds such as stigmasterol, quercetin, and avicularin, which have the potential to act as inhibitors of the α -amylase and α -glucosidase enzymes with solid activity, making them suitable for use in the treatment of diabetes (Tusnava *et al*., 2017).

Extracts from the Putri Malu plant resulted in a decrease in glycated hemoglobin (HbA1C) levels and an increase in glycolytic enzymes and insulin secretion. Konsue *et al*., (2017) investigated the antidiabetic effects of aqueous and hydroalcoholic extracts *of Mimosa pudica Linn in streptozotocin* (STZ) -induced diabetic rats. The results showed that *Mimosa pudica* showed antihyperglycemic effects by significantly reducing *Fasting Blood Glucose (FBG) levels* in diabetic animals. Singarapriyavardhanan *et al*., (2022) reported that oral administration of 400 mg/kg *Mimosa pudica extract* for 21 days significantly reduced serum glucose levels in *streptozotocin* (STZ)-induced diabetes in rats.

CONCLUSIONS

Mimosa pudica Linn is a plant growing a bush upright with thorny spots and a head flower shaped round with a red young color. Plant *Mimosa pudica* can utilized as alternative diabetes medication. Mimosa pudica Also contains group metabolites rich in secondary phenols, alkaloids, flavonoids, saponins, terpenoids, tannins, And coumarin. The shy princess plant also has pharmacological properties such as being anti-diabetic, antioxidant, antidepressant, anti-hyperlipidemia, anti-inflammatory, anti-hyperuricemia, and for healing burns.

COMPETING INTERESTS

The authors declare that there are no competing interests.

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