Pharmacy Education (2022) 22(2) 1 - 4
https://doi.org/10.46542/pe.2022.222.14

IAI SPECIAL EDITION

RESEARCH ARTICLE

The potential of *Mimosa pudica* L as an α-glucosidase inhibitor and antioxidant agent

Muhamad Afham, Hilwan Yuda Teruna, Rudi Hendra

Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Riau, Pekanbaru, Riau, Indonesia

Keywords
Antidiabetic
Antioxidant
Mimosa pudica

Correspondence
Rudi Hendra
Department of Chemistry
Faculty of Mathematics and Natural Sciences
Universitas Riau
Pekanbaru, Riau
Indonesia
rudi.hendra@lecturer.unri.ac.id

Abstract

Background: The *putri malu* plant (*Mimosa pudica* L.) is a South American and Central American native widely distributed throughout Indonesia. Indonesians utilise this plant as a herbal treatment to treat various ailments, including insomnia, acute eye inflammation, stone pee, fever, worms, bronchitis, and herpes. **Objectives:** This plant was studied for its antioxidant and α-glucosidase inhibitory activities using *n*-hexane, dichloromethane, ethyl acetate, and water extracts. **Method:** The aerial part of the plant was extracted with methanol and partitioned with *n*-hexane, dichloromethane (DCM), and ethyl acetate to obtain *n*-hexane (EHMP) dichloromethane (EDMP), ethyl acetate (EEMP), and water (EAMP) extracts. All extracts were analysed for their α-glucosidase inhibitor and antioxidants with the free radical *scavenging activity* method using DPPH. **Results:** EAMP showed antidiabetic activity with inhibition of 69.9% at a concentration of 500 ppm, and other extracts showed no α-glucosidase inhibition activity. For antioxidant activity, EDMP, EEMP, and EAMP showed relatively high activity with IC_{50} consecutively 77.4 ppm, 26.9 ppm, and 81.4 ppm, while EHMP had a reasonably low activity with IC50 635.6 ppm. **Conclusion:** The study results showed that *M. pudica* has considerable potential as a source of antidiabetics and natural antioxidants, so it is necessary to isolate secondary metabolites from the species.

Introduction

Diabetes Mellitus is a disease caused by a pancreatic disorder that causes insulin (a hormone that regulates blood sugar) levels to rise above ordinary. Diabetes mellitus-related metabolic changes can cause structural and functional changes in macromolecules in the body. Hypertension, oxidative stress, and inflammation are the primary causes of this biochemical disorder. Hyperglycemia-induced oxidative stress conditions in diabetes mellitus result in an increase in the free radical formation and a decrease in antioxidant capacity (Basha *et al*., 2012; Baynes, 2015).

α-Glucosidase is an enzyme that is critical for glucose absorption in the gastrointestinal tract. Inhibiting this enzyme's activity has been shown to lower blood glucose levels and prevent postprandial hyperglycemia in type-2 diabetes (T2DM) patients (Hasimu *et al.*, 2019). Increased Reactive Oxygen Stress (ROS) levels, such as mitochondrial superoxide in endothelial cells and endoplasmic reticulum stress, are associated with cellular and enzyme damage and lipid peroxidation, all of which contribute to the development and progression of insulin resistance and hyperglycemia. Hyperglycemia and insulin resistance are both associated with the generation of oxidative stress, resulting in impaired insulin action. It has been demonstrated that hyperlipidemia, like hyperglycemia, induces oxidative stress in the mitochondria. Additionally, studies have shown that antioxidants are effective in improving insulin action in studies (Folli *et al.*, 2011; Sarian *et al*., 2017). At the moment, most available antidiabetic medications have side effects and have been linked to an increase in diabetes-related complications. Specific α-glucosidase inhibitors have been isolated successfully from medicinal plants to develop new drugs with increased potency and fewer side effects than currently available drugs (El Ridhasya *et al.,* 2020).

The Putri Malu plant (*Mimosa pudica* L.) of the Fabaceae family is used to treat various ailments. This plant has anti-inflammatory, antidiabetic, antimicrobial, and antioxidant properties (Muhammad *et al*., 2016). Amalraj and Ignacimuthu (2002) reported that an ethanolic of the species' leaves had a significant hyperglycemic effect when given orally to normal and glucose-loaded mice at a dose of 250 mg/kg. As a result, we reported the α-glucosidase inhibitor and antioxidant activity of various extracts of *M. pudica* L. in this study.

Objectives

This plant was studied for its antioxidant activity and α-glucosidase inhibitor properties using several extracts.

Methods

Extraction

Samples were collected from the area surrounding Riau Province's Main Stadium, Jalan Naga Sakti. The species was identified at Riau University's Botanical Laboratory, Department of Biology, FMIPA. A total of 4.5 kg of the species' fine powder was extracted with methanol for 1x24 hours and then repeated three times. The extract was evaporated until it became a viscous methanol extract. The crude extract was dissolved in a 9:1 methanol: water mixture and partitioned with n-hexane to produce an n-hexane extract (EHMP). Water was added to the residue to obtain 40% (v/v), and it was partitioned with dichloromethane to obtain dichloromethane extract (EDMP). The residue's remaining methanol was evaporated and partitioned with ethyl acetate to produce ethyl acetate (EEMP) and water (EAMP) extracts (Hendra *et al*., 2020).

Antioxidant activity

Free radical scavenging activity against the DPPH (1,1-diphenyl-2-picryl hydrazyl) radical was used to determine antioxidant activity as mentioned by (Hendra *et al*., 2020).

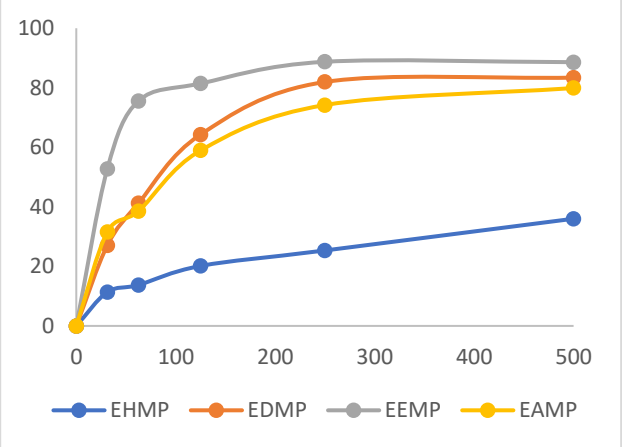
α-glucosidase inhibitor

The antidiabetic activity was determined by *in vitro* α-glucosidase inhibition method, as reported by El Ridhasya and colleagues (2020).

Results

Antioxidant activity

All of the extracts from the species were assessed for antioxidant activity using free radical scavenging activity against DPPH (1,1-diphenyl-2-picryl hydrazyl) radicals in this study. Figure 1 depicts the free radical scavenging activity of various extracts. The results revealed a linear relationship between concentration and percentage of inhibition among the extracts. At a concentration of 500 µg/mL, it was revealed that ethyl acetate extract had the highest inhibition with 88.6±1.63 %, while hexane extract had the lowest with 36.00±1.56 %.



Note: n-hexane (EHMP), dichloromethane (EDMP), ethyl acetate (EEMP), and water (EAMP) extracts

Figure 1: Antioxidant activity of various extracts from *M. Pudica*

The IC_{50} value of the extracts was calculated based on these results, and the results are shown in Table I. The ethyl acetate extract demonstrated higher activity with an IC_{50} value of 26,88 µg/mL than quercetin, which had an IC_{50} value of 47.09 µg/mL. The IC_{50} values for dichloromethane extract and aqueous extract were 77.41 and 81.65 µg/mL, respectively, indicating moderate antioxidant activity. The n-hexane extract had the least antioxidant activity, with an IC_{50} value greater than 500 µg/mL.

Table I: Antioxidant and α-glucosidase inhibition activity of *M. pudica* extracts

Sample	IC_{50} DPPH (µg/mL)	IC_{50} α-glucosidase (µg/mL)
n-hexane extract (EHMP)	> 500	>1000
Dichloromethane extract (EDMP)	77,41	>1000
Ethyl acetate extract (EEMP)	26,88	357,65
Aqueous extract (EAMP)	81,65	>1000
Quercetin	47,09	262,33

Antidiabetic activity

An *in vitro* α-glucosidase inhibition method was used to conduct an antidiabetic analysis on M. pudica extract. The percentage of inhibition of the extracts demonstrates a wide range of activities. Figure 2 shows that ethyl acetate inhibits α-glucosidase *in vitro* (69.9±1.08%) at 500 g/mL, whereas other extracts show no activity. The ethyl acetate extract has good inhibitory activity, with an IC_{50} value of 357.65 g/mL, which is comparable to quercetin's IC_{50} value of 262.33 g/mL (Table I). An *in vitro* -glucosidase inhibition method was used to conduct an antidiabetic analysis on *M. pudica* extract. The percentage of inhibition of the extracts demonstrates a wide range of activities. Figure 2 shows that ethyl acetate inhibits -glucosidase in vitro (69.9±1.08%) at 500 g/mL, whereas other extracts show no activity. The ethyl acetate extract has good inhibitory activity, with an IC_{50} value of 357.65 g/mL, which is comparable to quercetin's IC_{50} value of 262.33 g/mL (Table I).

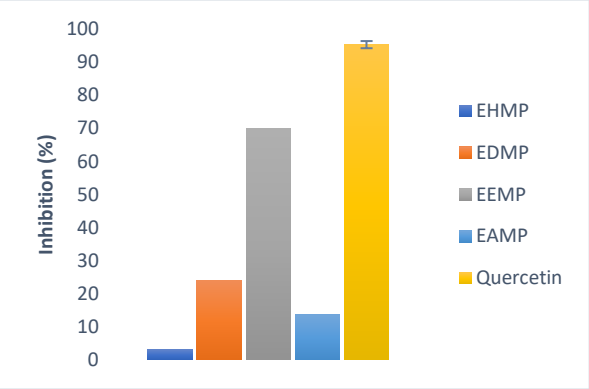


Figure 2: Percentage of Inhibition of Antidiabetic Activity of *M. Pudica* Extract and Quercetin at 500 µg/mL

Discussion and conclusion

In this study, a modified Kupchan partitioning technique was used to partition the methanol extract with different organic solvents. The Kuphan partition is an efficient but straightforward way to initiate a purification protocol by separating a total crude methanol extract to obtain four large extracts of different polarities, and the polarity distributions between extracts of various compounds can be quite diverse (Kupchan *et al*., 1976).

The results of this study indicated that *M. pudica* extracts possessed a variety antioxidant activity. The ethyl acetate extract exhibited significant antioxidant activity, exceeding that of positive control quercetin. It has been reported that quercetin, a flavonoid, which can be found in flowers, fruits, and leaves showed high antioxidant activities (Hendra & Keller, 2017; Hirano *et al*., 2001). In this study, the result was greater than that of Arokiyaraj and colleagues (2012) and Chowdhury and colleagues (2008), who reported IC_{50} values of 9 mg/mL and 296.92 µg/mL, respectively.

This is attributed to the flavonoid and phenolic content present in the extract. It has been reported that the flavonoids and phenolics have an essential role in antioxidant activity (Lakshamibai & Amirtham, 2018). This species was reported to contain quercetin, avicularin, and coumaric acid which have potent antioxidant activities (Muhammad *et al*., 2016; Tasnuva *et al*., 2019). Therefore, the antioxidant activity of ethyl acetate might be come from these compounds.

Additionally, when compared to other extracts, ethyl acetate extract demonstrated antidiabetic activity. This result is consistent with previously published reports that ethyl acetate from this species inhibited α-glucosidase by percentage of 51.87 at a concentration of 1000 µg/mL (Tunna *et al*., 2015). This is most likely due to the presence of secondary metabolites such as flavonoids and phenolic acids. Tasnuva and colleagues (2019) reported that this species contain quercetin and avicularin, which possesses α-glucosidase inhibition at IC_{50} value of 75.16 ± 0.92 481.7 µg/mL, respectively.

There is a correlation between the antioxidant and antidiabetic properties of the *M. pudica* extract based on the research that has been conducted. The ethyl acetate extract demonstrated the significant activity compared to the other extracts. It is suspected that secondary metabolites can act as antioxidants and inhibit α-glucosidase. Additionally, previous research has shown that plants high in antioxidants (primarily phenolics and flavonoids) correlate with therapeutic agents used to treat diabetes (Sunday, 2020).

Flavonoids with high antioxidant activity may help manage diabetes. Antioxidants' ability to protect against the deleterious effects of hyperglycemia while also enhancing glucose metabolism and uptake should be considered a primary treatment option for diabetes mellitus. Besides their antioxidant properties, flavonoids may act on biological targets associated with type 2 diabetes, such as α-glycosidase and dipeptidyl peptidase-4 (DPP-4). The total number and configuration of hydroxyl groups were crucial in regulating antioxidant and antidiabetic properties by scavenging DPPH radicals and optimizing both α-glucosidase and DPP-4 activity. The presence of a C-2-C-3 double bond and a C-4 ketonic group are two critical structural features for flavonoids' bioactivity,

particularly their antidiabetic activity (Sarian *et al*., 2017).

The present study indicates that ethyl acetate of *M. pudica* possess antioxidant in scavenging the DPPH radicals. It also shows significant inhibiting α-glucosidase. Further study is needed to examine the exact active compounds responsible for these biological activities.

Acknowledgements

The authors would like to express their gratitude to the Center for Research and Community Development at the University of Riau and the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia for their support.

References

Amalraj, T., & Ignacimuthu, S. (2002). Hyperglycemic effect of leaves of Mimosa pudica Linn. *Fitoterapia,* **73**(4), 351-352

Arokiyaraj, S., Sripriya, N., Bhagya, R., Radhika, B., Prameela, L., & Udayaprakash, N. (2012). Phytochemical screening, antibacterial and free radical scavenging effects of Artemisia nilagirica, Mimosa pudica and Clerodendrum siphonanthus–An in–vitro study. *Asian Pacific Journal of Tropical Biomedicine,* **2**(2), S601-S604

Basha, B., Samuel, S.M., Triggle, C.R., & Ding, H. (2012). Endothelial dysfunction in diabetes mellitus: possible involvement of endoplasmic reticulum stress? *Experimental diabetes research, **2012*** https://doi.org/10.1155/2012/481840

Baynes, H.W. (2015). Classification, pathophysiology, diagnosis and management of diabetes mellitus. *Journal of diabetes metabolism,* **6**(5), 1-9. https://doi.org/10.4172/2155-6156.1000541

Chowdhury, S.A., Islam, J., Rahaman, M.M., Rahman, M. M., Rumzhum, N.N., Sultana, R., & Parvin, M.N. (2008). Cytotoxicity, antimicrobial and antioxidant studies of the different plant parts of Mimosa pudica. *Stamford journal of pharmaceutical sciences,* **1**(1), 80-84

El Ridhasya, F., Rahim, N., Almurdani, M., Hendra, R., & Teruna, H.Y. (2020). Antidiabetic Constituents from Helminthostachys zeylanica (L) Hook (Ophioglossaceae). *Pharmacognosy Journal,* **12**(2)

Folli, F., Corradi, D., Fanti, P., Davalli, A., Paez, A., Giaccari, A., Perego, C., & Muscogiuri, G. (2011). The role of oxidative stress in the pathogenesis of type 2 diabetes mellitus micro- and macrovascular complications: avenues for a mechanistic-based therapeutic approach. *Current diabetes reviews,* **7**(5), 313-324. https://doi.org/10.2174/157339911797415585

Hasimu, P., & Adnyana, K. (2019). a-Glucosidase activity: Implication for Diabetes In R. R. Watson & V. R. Preedy (Eds.), *Bioactive Food as Dietary Interventions for Diabettes* (pp. 387-393). United Kingdom: elsevier

Hendra, R., Gurning, S.N., Panjaitan, U.P.A., & Teruna, H.Y. (2020). *Antioxidant activity of an Epiphyte Fern in Palm Oil Tree.* Paper presented at the Journal of Physics: Conference Series

Hendra, R., & Keller, P.A. (2017). Phytochemical studies on two Australian Anigozanthos plant species. *Journal of Natural Products,* **80**(7), 2141-2145

Hendra, R., Masdeatresa, L., Abdulah, R., & Haryani, Y. (2020). *Red dragon peel (Hylocereus polyrhizus) as antioxidant source.* Paper presented at the AIP Conference Proceedings

Hirano, R., Sasamoto, W., Matsumoto, A., Itakura, H., Igarashi, O., & Kondo, K. (2001). Antioxidant ability of various flavonoids against DPPH radicals and LDL oxidation. *Journal of Nutritional Science and Vitaminology,* **47**(5), 357-362

Kupchan, S., Shizuri, Y., Murae, T., Sweeny, J., Haynes, H., Shen, M., Barrick, J.C., Bryan, R.F., der Helm, D.V., & Wu, K.K. (1976). Gnidimacrin and Gnidimacrin-20-palmitate, novel macrocyclic anti-leukemic diterpenoid esters from *Gnidia subcordata*. *Journal of the American Chemical Society,* **98**, 5719-5720

Lakshamibai, R., & Amirtham, D. (2018). Evaluation of Free Radical Scavening Activity of Mimosa Pudica Thorns. *Asian Journal of Pharmaceutical and Clinical Research, **11***(11), 153-156

Muhammad, G., Hussain, M.A., Jantan, I., & Bukhari, S. N. A. (2016). Mimosa pudica L., a high-value medicinal plant as a source of bioactives for pharmaceuticals. *Comprehensive Reviews in Food Science and Food Safety, **15***(2), 303-315

Sarian, M.N., Ahmed, Q.U., Mat So'ad, S.Z., Alhassan, A. M., Murugesu, S., Perumal, V., Mohamad, S.N.A.S., Khatib, A., & Latip, J. (2017). Antioxidant and antidiabetic effects of flavonoids: A structure-activity relationship based study. *BioMed Research International*, **2017**, https://doi.org/10.1155/2017/8386065

Sunday, R.M. (2020). Antioxidant and Antidiabetic Properties of Mimosa pudica Seeds in Streptozotocin-induced Diabetic Wistar Rats. *Asian Journal of Biotechnology, **12***, 1-8

Tasnuva, S., Qamar, U., Ghafoor, K., Sahena, F., Jahurul, M., Rukshana, A., Juliana, M.J., Al-Juhaimi, F.Y., Jalifah, L., Jalal, K.C.A., Ali, M.E., Zaidul, I.S.M. (2019). α-glucosidase inhibitors isolated from Mimosa pudica L. *Natural Product Research, **33***(10), 1495-1499

Tunna, T., Zaidul, I., Ahmed, Q., Ghafoor, K., Al-Juhaimi, F., Uddin, M.S., Hasan, M., & Ferdous, S. (2015). Analyses and profiling of extract and fractions of neglected weed Mimosa pudica Linn. traditionally used in Southeast Asia to treat diabetes. *South African Journal of Botany, **99***, 144-152