

A SYSTEMATIC REVIEW OF THE POTENTIAL OF PHYTOTHERAPY AS A COMPLEMENTARY THERAPY FOR DIABETES MELLITUS: A FOCUS ON CLINICAL EVIDENCE

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Keywords	Abstract
diabetes mellitus, phytotherapy, medicinal plants, complementary therapy, blood glucose	Diabetes mellitus is a chronic metabolic disease with increasing prevalence worldwide, including in Indonesia, where the prevalence of diabetes in adults rose from 5.7% in 2007 to 8.5% in 2018. Conventional treatments like insulin and oral medications are effective in controlling blood glucose levels but are often associated with side effects. As a result, the use of natural ingredients or phytotherapy is increasingly sought as an alternative therapy. This study aims to evaluate the potential of natural ingredients as complementary therapies in managing Type 2 Diabetes Mellitus in Indonesia. A systematic review was conducted by accessing literature from multiple academic databases, including Google Scholar, PubMed, and Scopus. Of the 209 articles found, 13 met the inclusion criteria, involving original human research studies that investigated the use of natural ingredients for lowering blood glucose levels in Type 2 diabetes patients. The majority of natural ingredients studied, such as <i>Moringa oleifera</i> leaves, Binahong leaves, and Bitter melon, showed significant effects in lowering blood glucose levels, with preparations ranging from stews, teas, to juices. Natural ingredients show strong potential as complementary therapies in managing Type 2 Diabetes Mellitus. However, further research with larger experimental designs and additional clinical parameter measurements is needed to ensure the long-term effectiveness and safety of these herbal interventions.

INTRODUCTION

Diabetes mellitus is one of the main Non-Communicable Diseases (NCDs) that causes a significant burden globally and in Indonesia. The prevalence and mortality rate from diabetes continues to increase from year to year. Globally, the prevalence rose from 2,968 to 5,943 per 100,000 population between 1990 and 2019, while the death rate increased from 12.37 to 20.5 per 100,000. In Indonesia, the prevalence of diabetes in adults increased from 5.7% (2007) to 8.5% (2018) (Wahidin et al., 2024).

Diabetes mellitus (DM) is a chronic metabolic disease characterized by persistently high blood glucose levels. This condition can be caused by a disturbance in insulin secretion, resistance to the action of insulin in peripheral tissues, or a combination of the two. Diabetes mellitus consists of three main types: type I, type II, and gestational, with the main treatment focus on types I and II. Type I is caused by an autoimmune reaction that damages insulin-producing cells, while type II occurs due to the body's resistance to insulin. If left unchecked, diabetes can cause serious complications in vital organs such as the eyes, kidneys, nerves, heart, and blood vessels. Common complications of diabetes mellitus include diabetic retinopathy

(blindness), kidney failure, diabetic legs at risk of amputation, as well as an increased risk of cardiovascular diseases such as heart attack and stroke (Goyal et al., 2023)(Solis-Herrera et al., 2015)(Wang et al., 2022).

Diabetes is included in the priority of disease prevention and control programs in Indonesia, as listed in various national planning documents such as the Ministry of Health's Strategic Plan 2020-2024. Some of the national programs that support the handling of PTM include Posbindu, Pandu, and Prolanis. Local governments are also required to carry out diabetes screening and standard services through the Minimum Service Standards (SPM). Although these programs have the potential to influence the development of diabetes, data on their effectiveness are still limited (Ministry of Health RI, 2019).

Conventional treatments for diabetes, such as the use of insulin and oral medications (metformin and sulfonylurea), are effective in controlling blood glucose levels, but they are often accompanied by side effects such as hypoglycemia, gastrointestinal disorders, and long-term liver and kidney damage. In addition, high medical costs are also a burden in itself, especially in developing countries. The use of natural ingredients or phytotherapy as an alternative therapy for diabetes is increasingly in demand because it is considered safer, more affordable, and has fewer side effects. Various traditional medicinal plants such as sambiloto, red betel, crown of gods, binahong, bitter melon, moringa leaves, bandotan, basil, bay leaves, noni, and mulberries. These herbs have the potential as complementary therapies to control blood glucose levels in diabetics containing bioactive compounds such as flavonoids, alkaloids, saponins, and tannins that have the potential to lower blood glucose levels through various mechanisms, including stimulating insulin secretion and increasing its sensitivity (Lestari & Ariadi, 2025)(Anam et al., 2023).

Therefore, more in-depth scientific studies through clinical research are needed to assess the effectiveness and safety of these natural ingredients in humans. This process of scientification is important not only to support the integration of natural ingredients in modern evidence-based medical practices, but also to encourage the development of diabetes therapies that are more environmentally friendly, sustainable, and rooted in local wisdom.

METHOD

This systematic review was conducted by browsing the literature from multiple academic databases, including Google Scholar, PubMed, and Scopus, to increase the credibility of the findings. The search utilized keywords such as "phytotherapy", "medicinal plants", "Indonesia", "respondents", and "diabetes mellitus". The search was limited to articles published between 2020 and 2025. Of the 209 articles found, only 13 met the inclusion criteria. These criteria were defined as original human research studies that investigated the use of natural ingredients for lowering blood glucose levels in patients with diabetes mellitus, specifically type 2. Articles were excluded based on factors such as being review articles, duplicates, or irrelevant to the topic.

The inclusion/exclusion criteria considered the study design (randomized controlled trials, cohort studies, case-control studies), the type of population (human participants with diabetes mellitus), and the outcome parameters (blood glucose level reduction).

The data extracted from the selected articles included the type of plant used, the form of preparation, the study location, the research design, and the reported effect on glucose levels. The analysis was initially descriptive to assess the potential of phytotherapy as a complementary therapy for type 2 diabetes. Additionally, a meta-analysis will be considered for future reviews to quantitatively synthesize the effects of phytotherapy across studies, thereby enhancing the robustness of the findings.

RESULTS AND DISCUSSION

Of all the materials studied, *M. oleifera* leaves were the most frequently tested plants, namely in four different studies. In both decoction and tea form, *M. oleifera* has shown the ability to consistently lower blood glucose levels. It is supported by the content of active compounds such as flavonoids, chlorogenic acid, and isothiocyanate. The compound plays a role in improving insulin sensitivity, inhibiting glucose absorption and acting as a natural antioxidant. In addition to (Tumer et al., 2015; Waterman et al., 2014) *M. oleifera*, the leaves of *Muntingia calabura* also showed hypoglycemic effects in two different studies, although they were carried out at different locations and times. This plant contains polyphenols and flavonoids that help improve glucose metabolism (Niwele et al., 2020; Solikhah & Solikhah, 2021).

Momordica charantia, which is widely known as an antidiabetic plant, has been shown to be effective in lowering blood sugar levels when given in the form of juice twice a day. The content of charantin, polypeptide-P, and vicine has an effect that resembles natural insulin. Similarly, binahong leaves (Kumaree & Prasansuklab, 2023; Saeed et al., 2021) *Anredera cordifolia*) contain saponins and alkaloids that help stimulate β -pancreatic cells and improve insulin function (Dwitiyanti et al., 2021; Latuhihin et al., 2020).

Table 1. Research Data

Research Sample	Heading	Location	Research Design	Result	Source
Jicama	The Effect of Jicama Biscuit Consumption on Glycemic Index in DM Sufferers	Bangkinang, Kampar, Riau	Experiment with the T-Test	Lowers the glycemic index (p=0.000)	(Riani et al., 2020)
Brown & Black Rice	Giving Brown and Black Rice to Changes in Glucose Levels in DM Patients	Kendari City	Quasi-experiment (pre-test design)	Significantly lowered blood glucose levels (p=0.000)	(Ardiansyah & Nawawi, 2021)
Baked Leaves	Effect of Binahong Leaf Stew on Blood Sugar Levels of Type 2 DM Sufferers	Rejosari Health Center, Pekanbaru	Quasi experiment (pretest-posttest)	Significantly lowering blood sugar levels (p=0.000); contains saponins, flavonoids, alkaloids	(Handayani et al., 2022)
Moringa Leaves	The Effect of Moringa Leaf Stew on Blood Sugar Levels in Type II Diabetes Mellitus Patients in Balam Jaya Village, Mining Health	Balam Jaya Village, UPT Mining Health Center	Pre-experiment (pretest-posttest)	The average decreased from 247.52 → 176.04 mg/dl (p=0.000)	(Novianty et al., 2023)

	Center Upt Working Area				
	Differences in the Effectiveness of Moringa Leaf and Apple Juice Stew on Blood Sugar Levels	Not mentioned	Pre-experiment (pretest-posttest)	Moringa leaves are more effective than apple juice (p=0.001)	(Risnawati & Demmalewa, 2022)
	The Effectiveness of Moringa Leaf Stew to Lower Blood Sugar Levels	UPT Tanjung Morawa Health Center	Pre-experiment (pretest-posttest)	Effective in lowering glucose levels (p=0.000)	(Waruwu et al., 2022)
	The Impact of Moringa Leaf Tea on Blood Glucose Levels in Type 2 DM Patients	Cakung Health Center, East Jakarta	Pretest-posttest control group design	Moringa leaf tea 200 ml significantly lowers blood sugar (p=0.01)	(Rofianti & Septiani, 2022)
Cherry Leaves	Effect of Kersen Leaf Decoction Therapy on Lowering Blood Sugar Levels	Sa'dan Malimbong Health Center, North Toraja	Quasi-experiment (pretest-posttest)	Significantly lowered blood sugar levels (p=0.008)	(Allo & Patabang, 2023)
	Effect of Kersen Leaf Decoction Therapy on Lowering Blood Sugar Levels	Sa'dan Malimbong Health Center, North Toraja	Quasi-experiment (pretest-posttest)	Significantly lowered blood sugar levels (p=0.008)	(Ranteallo et al., 2022)
Bitter melon	Bitter Melon Juice Lowers Blood Sugar Levels in Patients with Diabetes Mellitus	Dawe Health Center Working Area	Quasi experiment (pretest-posttest with controls)	Bitter melon juice 2×250 ml/day for 1 week significantly lowers blood sugar levels (p=0.000)	(Dewi et al., 2024)
Bezelnut, Areca Nut, Ginger	Effect of Herbal Decoction as Maintenance Therapy for Type 2 DM Patients	Not mentioned	Two-group experiment (control vs treatment)	Herbal decoction lowers blood sugar levels significantly (p=0.000)	(Sulami & Qamarya, 2021)
Soursop Leaves	Effectiveness of Soursop Leaf Decoction	Lowungu Village, Bejen District	Case study (2 people)	Subject 1: significant decline; Subject	(Asriyanto & Anisah, 2025)

	for Blood Glucose Level Stability in Type 2 DM Patients			2: insignificant. Potential to stabilize glucose	
Olive Oil & Honey	The Effect of Olive Oil and Honey Feeding on Blood Glucose Reduction in Type 2 DM Patients	Kabila Health Center, Gorontalo Regency	One group pretest-posttest	Significant reduction: from 94.5% >126 mg/dl and 88% <200 mg/dl	(Tomayahu et al., 2022)

The combination of betel, ginger, and areca nut has also been shown to have significant hypoglycemic effects. Ginger (*Zingiber officinale*) contains gingerol and shogaol which increase the absorption of glucose by peripheral tissues. Betel nut with eugenol content acts as an anti-inflammatory and increases insulin activity, while betel nut contains tannins that inhibit the absorption of carbohydrates in the intestines (Li et al., 2012, 2012)(Tarmale et al., 2024) .

Other natural ingredients that also show hypoglycemic effects are brown rice (*Oryza glaberrima*) and black rice (*Oryza sativa L. indica*) which contain anthocyanins and high fiber. This compound is able to slow down the absorption of carbohydrates and increase insulin sensitivity. Meanwhile, jicama (Sun et al., 2022) *Pachyrhizus erosus*) tested in the form of biscuits, was shown to lower the glycemic index. The content of inulin as a prebiotic fiber that slows down the postprandial glucose spike . Research on soursop leaves (Tang et al., 2024) *Annona muricata* L) also yields interesting results, although it is a case study. One of the subjects showed a significant decrease in blood glucose levels, while the other did not, indicating that the effectiveness could be individual and still requires further study. Finally, the combination of olive oil and honey also showed the ability to significantly lower blood glucose levels. The oleic acid and polyphenol content of olives, as well as the natural flavonoids and fructose of honey, are thought to work through mechanisms of decreasing oxidative stress and increasing glucose metabolism (Lafraxo et al., 2021).

Overall, the results of this study show that most of the natural ingredients studied have a significant effect in lowering blood glucose levels, thus showing strong potential as a complementary therapy in the management of type 2 Diabetes Mellitus. The use of these natural ingredients also shows flexibility in the form of preparations, ranging from stews, teas, juices, to biscuits, which opens up opportunities to be further developed into functional food products and phytopharmaceuticals that are safe, effective, and standardized. Nonetheless, further research with large-scale experimental designs, stricter control of variables, and measurement of additional clinical parameters such as HbA1c, lipid profile, and insulin levels is needed to ensure the long-term effectiveness and safety of such herbal interventions.

CONCLUSION

This study demonstrates that most of the natural ingredients tested have a significant effect in lowering blood glucose levels, showing strong potential as a complementary therapy in the management of Type 2 Diabetes Mellitus. Various natural ingredients, such as Moringa leaves, Binahong leaves, and Bitter melon, have shown consistent effectiveness in reducing glucose levels. Future research should conduct larger experimental studies with stricter control of variables and measurement of additional clinical parameters such as HbA1c, lipid profile, and insulin levels to ensure the long-term effectiveness and safety of such herbal interventions. The implications of these findings highlight the importance of introducing natural ingredients

as part of safe and affordable alternative therapies for diabetes patients, and encouraging the development of functional food products and phytopharmaceuticals based on local plants that can help manage diabetes in a more sustainable and culturally grounded manner.

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