

Systematic Review

The Effect of THM (Traditional Herbal Medicine) On Reducing Blood Sugar Levels in Type 2 Diabetes Mellitus Patients in Indonesia: A Sytematic Review and Meta-Analysis

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ABSTRACT

Background: Diabetes is a global health issue that currently receives widespread attention. Indonesia, a tropical archipelagic nation and a hotspot for biodiversity, offers a rich array of natural resources, making the use of herbal plants or traditional medicine a popular treatment option among the public. This study aims to conduct a systematic review and meta-analysis regarding the effect of THM (traditional herbal medicine) on blood sugar reduction in patients with type 2 diabetes.

Methods: This study aims to conduct a systematic review and meta-analysis regarding the effect of THM (traditional herbal medicine) on blood sugar reduction in patients with type 2 diabetes. This study was conducted using a systematic review method followed by meta-analysis, which is a statistical technique to quantitatively combine the findings from previous studies.

Results: The review found that the intervention of boiling leaves of bay leaf (PMD: -39.09 mg/dL), moringa leaves (PMD: -50.98 mg/dL), and ginger (PMD: -53.45 mg/dL) significantly influenced blood sugar reduction in patients with type 2 diabetes (p -value < 0.001).

Conclusion: The analysis shows a significant reduction in blood sugar in type 2 diabetes patients after the administration of ginger, bay leaf, and moringa leaf decoctions, with a decrease of 5.83 mg/dL per day. Health professionals can provide appropriate education on their use alongside standard diabetes management.

ARTICLE HISTORY

Received: December 31st, 2025

Accepted: September 02nd, 2026

KEYWORDS

bay leave; moringa leaves; glucose blood level; diabetes mellitus; medicinal plants

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Cite this as: Syahrini, A., & Insani, A. (2026). The Effect of THM (Traditional Herbal Medicine) On Reducing Blood Sugar Levels in Type 2 Diabetes Mellitus Patients in Indonesia: A Sytematic Review and Meta-Analysis. *Jurnal Kebidanan dan Kesehatan Tradisional*, 11(2), 123-135. <https://doi.org/10.37341/jkkt.v11i2.677>

INTRODUCTION

Diabetes is a global health issue that is currently receiving widespread attention. In 2021, diabetes was the direct cause of 1.6 million deaths, with 47% of all diabetes-related deaths occurring before the age of 70 (World Health Organization, 2020). The 2023 Indonesian Health Survey (SKI) and the 2018 Basic Health Research (Riskesdas) reveal that the prevalence of diabetes in Indonesia is deeply concerning. The prevalence of

people living with diabetes in Indonesia showed an upward trend, increasing from 6.9% in 2013 to 10.9% in 2018 (Badan penelitian dan pengembangan kesehatan kementerian RI tahun 2023, 2023).

People with diabetes use various methods for treatment, such as taking medications through pharmacotherapy or oral drugs, as well as insulin injections (Adiputra, 2023). Indonesia, which has a tropical climate, is the second most biodiverse country in the world after Brazil. It is home to approximately 25.000 to 30.000 plant species, representing 80% of the world's plant species and 90% of those in Asia. Due to the rich biodiversity, the use of herbal plants or traditional medicine is a popular treatment option among the public. Factors driving people to utilize natural remedies include the high cost of modern or synthetic drugs and their associated side effects. Additionally, mass media promotion plays a key role in boosting the use of natural medicine (Sun et al., 2024)

Based on previous research, decoctions of plants such as ginger (*Zingiber officinale*), Indonesian bay leaf (*Syzygium polyanthum*), and moringa (*Moringa oleifera*) significantly lower blood sugar levels in patients with type 2 diabetes mellitus (DM tipe 2)(Mukhlisin & Suwanti, 2023). In light of the concerning prevalence of diabetes mellitus (*IDF Diabetes Atlas*, 2025) and the critical role of blood sugar management in achieving positive health outcomes, various strategies to lower blood glucose levels are essential. The use of herbal plants as complementary therapy may be an alternative that healthcare professionals can consider supporting blood sugar management in patients with diabetes mellitus.

As Indonesia have rich biodiversity including various plants suitable for traditional medicine(Astuti et al., 2025), this wealth offers an opportunity to develop medicinal plants as a complementary therapy for type 2 diabetes mellitus(Fatin & Mohd, 2023), particularly for blood glucose control. The use of plant-based complementary remedies presents a promising alternative(Hidayat et al., 2021), as these plants contain bioactive compounds believed to possess antihyperglycemic activity. However, their use requires scientific evidence regarding efficacy, safety, dosage, and mechanisms of action; therefore, research into the potential of Indonesian medicinal plants as complementary therapies aimed at lowering blood glucose levels in type 2 diabetes patients supports the development of treatments based on Indonesia's natural resources.

Therefore, this study aims to identify and evaluate the available literature on herbal plants for reducing blood sugar levels in patients with diabetes mellitus. This research utilizes systematic review and meta-analysis on the effect of traditional herbal medicine on lowering blood glucose in type 2 diabetes patients. The findings are intended to serve as recommended prevention strategies, particularly for managing high blood sugar levels.

MATERIALS AND METHOD

Research Design

A systematic review approach was adopted, followed by a meta-analysis. This study aimed to provide a comprehensive overview of the effectiveness of medicinal plants as an aid in lowering blood sugar levels in patients with type 2 diabetes mellitus. Researchers employed this method to systematically identify, select, and evaluate relevant studies based on established criteria, thereby minimizing bias.

Subsequently, a meta-analysis was used to quantitatively pool research findings, allowing for an overall effect estimate and increased statistical power compared to relying on the results of a single study. Therefore, the use of systematic review and meta-analysis

is considered appropriate for providing stronger scientific evidence regarding the effectiveness of medicinal plants as an alternative for blood sugar control in type 2 diabetes patients. This study was conducted using a systematic review method which was then followed by meta-analysis, namely a statistical technique to combine findings from previous studies quantitatively (Page et al., 2021). This study uses the Preferred Reporting Items for Systematic Reviews and Meta-Analysis method (PRISMA) (Page et al., 2021). This method can also answer the question: In patients with type 2 diabetes mellitus, is the use of traditional medicinal plants effective in lowering blood glucose levels?

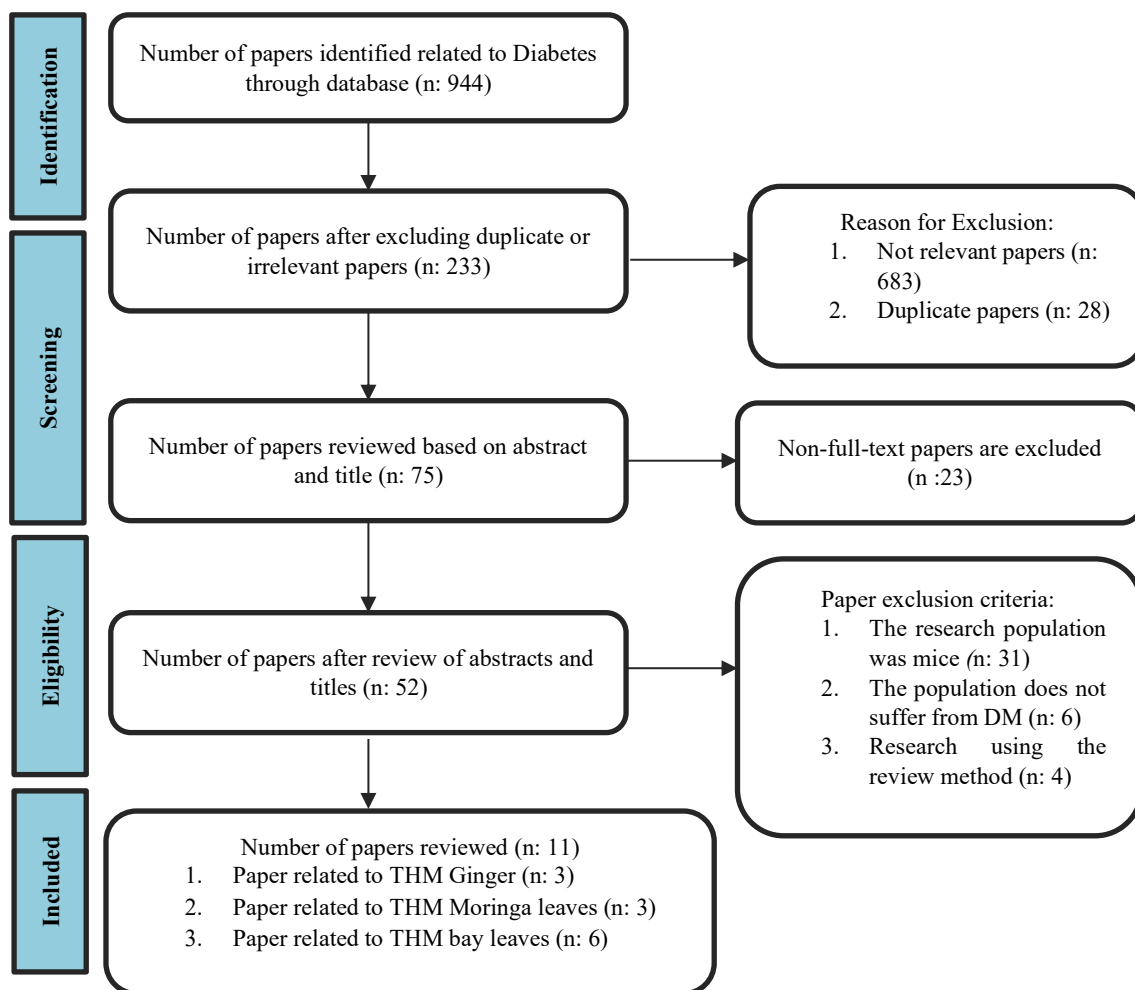
Search Strategy

This method consists of four phases: identification, screening, eligibility, and eligibility criteria. The study search was conducted through Google Scholar, ResearchGate, and Garuda databases using keywords including "THM," "Ginger," "Bay Leaves," "Moringa Leaves," "Diabetes," and "Blood Sugar" from February 3 to 5, 2025. The inclusion criteria set by the researchers included studies in Indonesian and English, reporting the effect of Traditional Herbal medicine on blood sugar levels, with a population of type 2 diabetes patients (blood sugar >200 mg/dl), and a study location in Indonesia. Exclusion criteria included duplicate articles, non-full-text articles, and mice as study samples.

Screening and Selection of Studies

Study screening was conducted by two authors (AI and AS) on the titles and abstracts of potential studies. Full articles were then read independently by both researchers to identify studies that met the pre-established inclusion criteria. The meta-analysis was conducted using the statistical applications Revman 5.4 and JAMOVI version 2.0.0. Researchers determined the pooled mean difference (PMD) with a 95% confidence interval as a measure of effect, presented in the form of a forest plot. Bubble plots were used to examine the effect of intervention duration on the pooled mean difference (PMD) results of the effects of bay leaves, ginger, and moringa leaves on reducing blood sugar levels.

Risk of Bias in this study using standardized Cochrane risk of bias assessment tools. Heterogeneity testing in the study was performed by removing the I² statistic value. If the results show <50%, then the data is considered homogeneous and the analysis is carried out using fixed effects, whereas if >50%, the data will be considered heterogeneous, and the analysis is carried out using random effects. Egger's test and funnel plot were performed to identify publication bias. If the Egger regression test results show $p < 0.05$, the study is suspected of having publication bias.



Flow Chart 1. The PRISMA Method of Selecting Studies Included in the Review

RESULT

Based on the PRISMA results, 11 studies were eligible for meta-analysis. These 11 studies included three studies discussing the effect of moringa leaves on blood sugar, two studies discussing the effect of ginger on blood sugar, five studies discussing the effect of bay leaves on blood sugar, and one study discussing the effect of ginger and bay leaves on blood sugar (Table 1).

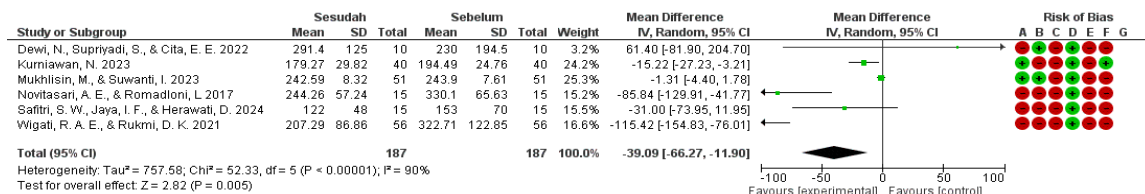
Based on Figure 1. the review results found that the intervention of boiled bay leaves (PMD: -39.09 Mg/dL (CI 95%: -66.27, -11.9)), moringa leaves (PMD: -50.98 Mg/dL (CI 95%: -64.37, -37.6)), and ginger (PMD: -53.45 Mg/dL (CI 95%: -60.96, -45.94)) significantly affected the reduction of blood sugar levels in patients with type 2 diabetes (p -value <0.001). In addition, the results of the heterogeneity test showed that the variables of bay leaves and moringa leaves were categorized as heterogeneous ($I^2 > 50\%$), while the ginger variable was found to be homogeneous ($I^2 < 50\%$).

The results of meta-regression showed that there was a significant influence between the length of intervention on the effect of boiled ginger, bay leaves, and moringa leaves on blood sugar levels in type 2 DM patients. The results of the analysis explained that there was a significant decrease in blood sugar in type 2 DM patients after being given boiled ginger, bay leaves, and moringa leaves by 5.83 mg/dl per day.

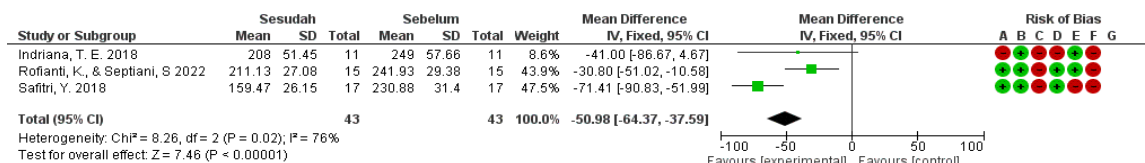
Table 1. Summary of Included Studies on Antidepressants and Telehealth-Based Interpersonal Psychotherapy (n = 14 articles)

No	Author	Year	n Sample	Sample Group	Design study	Types of THM	Report on How Long the Intervention	Length of Intervention Days
1	.(Mukhlisin & Suwanti, 2023)	2023	51	Type 2 Diabetes Mellitus	Quasy Experiment	Bay leaf	Not Reported	0
2	Wigati, R. A. E., & Rukmi, D. K.(Wigati & Rukmi, 2021)	2021	56	Type 2 Diabetes Mellitus	Quasy Experiment	Bay leaf	Reported	14
3	Safitri, S. W. <i>et al</i> (S. W. Safitri et al., 2024)	2024	15	Type 2 Diabetes Mellitus	Quasy Experiment	Bay leaf	Reported	6
4	Suharto, I. P. S. <i>et al</i> (Suharto et al., 2019)	2019	16	Type 2 Diabetes Mellitus	Quasy Experiment	Ginger	Reported	7
5	Kurniawan, N. <i>et al</i> (Kurniawan et al., 2023)	2023	40	Type 2 Diabetes Mellitus	Quasy Experiment	Bay leaf	Not Reported	0
6	Dewi, N., Supriyadi, S., & Cita, E. E. (Dewi et al., 2022)	2022	10	Type 2 Diabetes Mellitus	Quasy Experiment	Bay leaf & Ginger	Reported	6
7	Novitasari, A. E., & Romadloni, L (Novitasari & Romadloni, 2017)	2017	15	Type 2 Diabetes Mellitus	Quasy Experiment	Bay leaf	Reported	6
8	Hendri, H. (Hendri, 2024)	2024	20	Type 2 Diabetes Mellitus	Quasy Experiment	Ginger	Not Reported	0
9	Indriana, T. E. (Indriana, 2018)	2018	11	Type 2 Diabetes Mellitus	Quasy Experiment	Moringa leaves	Reported	5

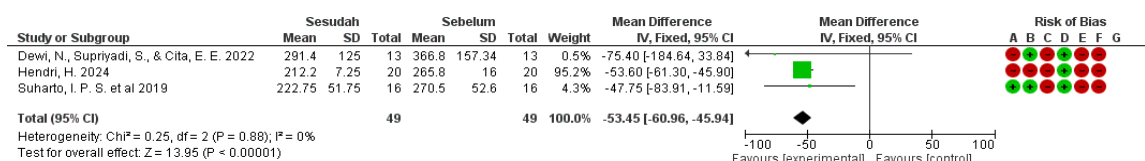
No	Author	Year	n Sample	Sample Group	Design study	Types of THM	Report on How Long the Intervention	Length of Intervention Days
10	Safitri, Y. (Y. Safitri, 2018)	2018	17	Type 2 Diabetes Mellitus	Quasy Experiment	Moringa leaves	Not Reported	0
11	Rofianti, K., & Septiani, S (Rofianti & Septiani, 2022)	2022	15	Type 2 Diabetes Mellitus	Quasy Experiment	Moringa leaves	Reported	14



(a)



(b)



(c)

Figure 1. (a) Forest Plot of the Effect of Bay Leaves on Blood Sugar, (b) Forest Plot of the Effect of Moringa Leaves on Blood Sugar, (c) Forest Plot of the Effect of Ginger on Blood Sugar

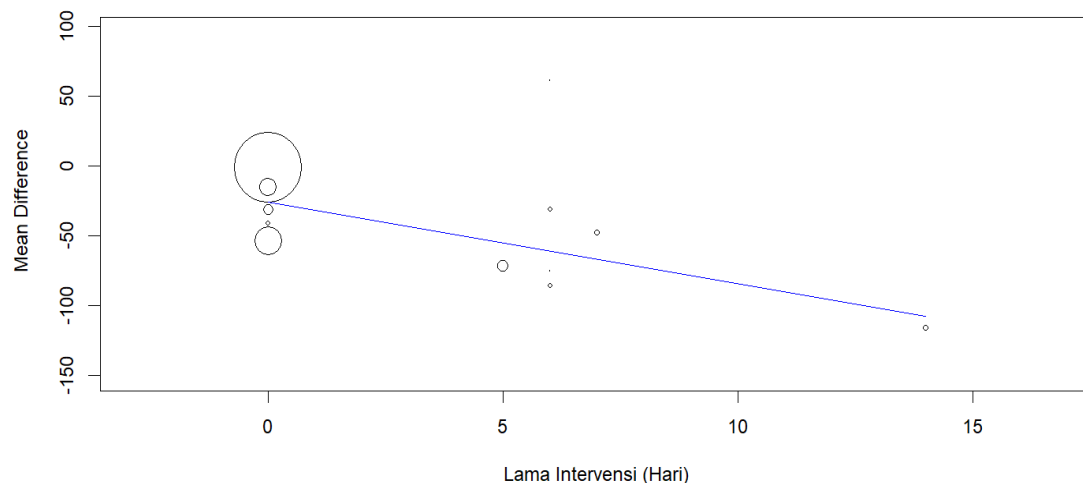


Figure 2. Bubble Plot of Meta-Regression of the Effect of THM Intervention on Blood Sugar Levels in Type 2 DM Patients Based on the Duration of Intervention

Table 2. Meta-Regression of the Effect of THM Intervention on Blood Sugar Levels in Type 2 DM Patients Based on the Duration of Intervention

Covariate	Coefficients	Lower bound	Upper bound	Std. error	p-Value
Intercept	-26.037	-42.301	-9.773	8.298	0.002
Intervention Duration (Days)	-5.829	-9.128	-2.529	1.683	<0.001

DISCUSSION

Geographically, this review was restricted to prior studies conducted in Indonesia. Several characteristic patterns emerged across the individual studies: all were situated in rural areas, relied exclusively on observational designs using quasi-experimental methods, and some even omitted the duration of the observation period (63%). The quality of each study was categorized as low, with performance bias and reporting bias predominated as a result of methods limited to observational execution without direct intervention. Nevertheless, this study was conducted to examine the direct impact of TOGA and to provide recommendations for future research.

The results of this study review found that bay leaf water processed into a drink has the effect of significantly lowering blood sugar levels (Dewi et al., 2022; Kurniawan et al., 2023; Mukhlisin & Suwanti, 2023; Y. Safitri, 2018; Wigati & Rukmi, 2021). From previous studies, Bay leaf extract can serve as an effective therapy for managing diabetes complications and lowering Glucose levels (Sofiyanti et al., 2026; Waheb et al., 2024).

This study also found a decrease in blood sugar levels in diabetes patients due to consuming processed ginger water (Dewi et al., 2022; Hendri, 2024; Pakan et al., 2021). Ginger is believed to be able to lower blood sugar levels because it contains antioxidants from ginger such as gingerol, shogaol, paradol, and zingeron which can increase glucose transport and insulin resistance tolerance in humans and animals because these contents can act by increasing the function of pancreatic cells through stimulation of insulin formation which has an impact on changing glucose into glycogen by polymerization (glycogenesis) (Alharbi et al., 2022).

The results of this study review also found a decrease in blood sugar levels in diabetes patients after consuming processed moringa leaves (Rofianti & Septiani, 2022; Zebua et al., 2026; Zuhra & Junita, 2025). Moringa leaves themselves contain phytochemicals that act as anticancer (Mumtaz et al., 2021), antibacterial, and hypotensive agents (El-sherbiny et al., 2024). Furthermore, they can gradually reduce hyperglycemic conditions and act as antioxidants and antidiabetics (Danyaro, 2026; Mthiyane et al., 2022).

Meta-analysis study of global RCT report of THM using on diabetes patient also found that THM have positive impact on decreasing blood sugar levels on diabetic patient (Fatony et al., 2021). Regular consumption of processed traditional herbal medicine (THM) can have a positive impact on lowering blood sugar levels in diabetic patients ($P < 0.05$). THM's potential is not limited to lowering blood sugar levels, but also affects other health factors, such as nausea and vomiting, gastrointestinal function, pain, inflammation, metabolic syndrome, and other disease symptoms (Anh et al., 2020; Ballester et al., 2023).

In Indonesia, there is a very diverse range of THM plants, where according to the Trade Assessment and Development Agency (2017), Indonesia has 30.000 plant species out of 40.000 species of medicinal plants in the world. (Mu'arifuddin et al., 2024). However, according to Riskesdas 2018, the use of THM in Indonesia is still very low (24.6%) (Kemenkes RI, 2018). Therefore, the use of THM requires socialization and direction from the authorities to the community due to its effects on health and the ease of access to THM plants in Indonesia.

The findings of this review have several implications for clinical practice, public health and future research. The reduction in blood glucose levels observed following the consumption of preparations made from bay leaves, ginger and moringa leaves suggests that traditional medicinal plants (TOGA) have the potential to be used as a complementary approach in the management of diabetes, particularly amongst communities with easy access to these medicinal plants. However, TOGA cannot be regarded as a substitute for standard diabetes therapy, and their use must be accompanied by education and guidance from healthcare professionals to ensure safety, correct usage, appropriate dosing, and the potential for interactions with conventional antidiabetic medicines. At the community level, healthcare professionals can provide evidence-based education on the benefits, limitations, and safe use of TOGA so that the public can make informed decisions regarding diabetes management.

Ultimately, this review has several limitations. All included studies have a high risk of bias (detection bias, selection bias, and reporting bias) due to small sample sizes, heterogeneity ($I^2 > 50\%$), and the use of a non-interventional research design, specifically quasi-experimental methods. This is largely driven by the narrow range of study designs among the primary literature. Consequently, this review recommends incorporating other study designs, such as Randomized Controlled Trials (RCTs), standardized herbal preparations, longer follow-up periods, and multicenter setting in future research. Nevertheless, a key strength of this study lies in successfully demonstrating the positive effects of THM utilization based on its duration of use.

CONCLUSION

The results of this study found that the intervention of boiled bay leaves, moringa leaves, and ginger significantly affected the reduction of blood sugar levels in patients with type 2 diabetes. Not only that, but this study also found that there was a significant reduction in blood sugar levels if THM was consumed continuously. Based on the findings of this study, regular consumption of bay leaf, Moringa leaf, and ginger infusion (THM) may be considered a complementary intervention to support blood glucose control in patients with type 2 diabetes mellitus. Healthcare professionals, particularly nurses, can provide education regarding the potential benefits of THM while emphasizing that its use should complement, rather than replace, prescribed medical treatment. Patients must remain compliant with their medication, dietary management, physical activity, and routine blood glucose monitoring. These findings also have implications for nursing practice by providing evidence on the potential use of THM as a culturally acceptable complementary approach in diabetes management.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to the Faculty of Public Health, Universitas Islam Negeri Sumatera Utara, Medan, Indonesia, for the support and

facilities provided during the conduct of this study. The authors also extend their appreciation to all parties who contributed to the completion of this research.

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