The Potential of Red Betel Leaf and Mangosteen Peel in Lowering Blood Sugar Levels in Patients with Diabetes Mellitus

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Abstract: A study comparing the effects of red betel leaf decoction, mangosteen peel juice, and conventional medication on blood glucose levels in individuals with type II diabetes mellitus was conducted in Indonesia. The research involved three groups of eight participants each, selected through purposive sampling. Following administration, the average blood glucose level was 190.75 mg/dL for red betel leaf decoction, 194.38 mg/dL for mangosteen peel juice, and 186.50 mg/dL for conventional medication. Surprisingly, there was no significant difference in the effectiveness of red betel leaf decoction and mangosteen peel juice in managing blood sugar levels, with a p-value of 0.582 ($p<0.05$). These findings suggest that both herbal interventions are comparable to conventional medication in regulating blood glucose levels among type II diabetes patients. In conclusion, the study highlights the potential of red betel leaf and mangosteen peel as alternative non-pharmacological interventions for managing diabetes. Further research is warranted to explore their mechanisms of action and long-term effects on diabetes management

Keywords: Blood sugar level; Diabetes mellitus; Mangosteen skin juice; Red betel leaf

Introduction

Diabetes Mellitus (DM) is a chronic disease with a steadily increasing prevalence (Hurst et al., 2020; Petersmann et al., 2019). According to the 2018 RISKESDAS data, the prevalence of DM in Indonesia rose from 6.9% to 8.5%. In the Jambi Province, the prevalence of Diabetes Mellitus, based on doctor's diagnoses in individuals aged ≥15 years, increased from 1.1% in 2013 to 1.5% in 2018 (Milita et al., 2021). Furthermore, data from the Kerinci District Health Office revealed a significant increase in DM cases from 625 in 2019 to 950 in 2020, reaching 999 cases in 2021, with Puskesmas Siulak Gedang ranking first for DM cases in its sub-district. In 2019, Puskesmas Siulak Gedang reported 298 DM cases, which escalated to 394 in 2020, and in 2021, it held the second position with 408 cases. In the first quarter of 2022, 35 Type II diabetes patients underwent monthly routine check-ups at Puskesmas Siulak Gedang (Puskesmas Siulak Gedang, 2022).

Several factors contribute to the high prevalence of DM, with lifestyle factors such as dietary patterns, physical activity, obesity, and stress being the most significant contributors (Dafriani et al., 2021; Dafriani, 2018). Sustained elevated blood sugar levels lead to various complications in DM patients, including cardiovascular disorders, neuropathy, nephropathy, retinopathy (Dafriani et al., 2019; Dafriani, Lipoeto, et al., 2018), and more, consequently increasing morbidity and mortality rates (Farhan et al., 2023; Maruhashi et al., 2021).

The management of blood sugar levels involves both pharmacological (Mawarti et al., 2018) and non-pharmacological approaches (Hartika et al., 2024; Oktorina et al., 2022). Several types of DM medications are available, but non-adherence to treatment regimens due to unpleasant side effects and medication fatigue

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poses challenges in controlling blood sugar levels (Agustikawati et al., 2021; Almasdy et al., 2015; Widodo et al., 2016).

Kerinci, Jambi, is blessed with abundant natural resources that can be harnessed for health purposes (Dişsiz et al., 2016). Among the frequently consumed medicinal plants for DM patients are mangosteen peel and red betel leaf, both readily available in the local environment (Agustikawati et al., 2021; Hartika et al., 2024). Studies have elucidated the active components of these plants (Kurang, 2023). According to Laili et al. (2020), mangosteen peel juice lowered blood sugar levels significantly compared to the control group ($p < 0.001$). Similarly, Arman et al. (2021) found that red betel leaf consumption led to a significant reduction in blood sugar levels ($p < 0.000$) among the intervention group.

Red betel leaf contains flavonoids with hypoglycemic activity, reducing blood glucose levels and the risk of DM-related complications (Yulianti et al., 2023). Isoflavones in red betel leaf enhance insulin secretion, aid in blood sugar control, and protect against oxidative stress (Hartika et al., 2024). Tanin, found in red betel leaf, acts as an antidiabetic agent, stimulating glucose transport via insulin receptors, akin to insulin (Farhan et al., 2023).

Mangosteen, a herbal plant, is believed to help reduce blood sugar levels in DM patients. It contains xanthones that reduce insulin resistance, normalize blood glucose levels, and alleviate fatigue caused by unbalanced blood sugar (Shori et al., 2018). Its antioxidants mitigate organ damage from hyperglycemia, and its antibacterial properties protect DM patients from infection risks (Hardani et al., 2023; Idawati et al., 2019; Safrida et al., 2023).

This research presents a novel approach to address the escalating prevalence of Diabetes Mellitus (DM) in Kerinci, Jambi, by harnessing the abundant natural resources of the region (Dafriani & Gusti, 2018; Dafriani, 2022). Unlike previous studies focusing on either mangosteen peel or red betel leaf individually, this research stands out by simultaneously exploring the effects of both herbal remedies on blood sugar levels within the same timeframe (Ibrahim et al., 2019; Suri et al., 2021). By integrating these two traditional treatments and comparing their impacts, this study offers a comprehensive evaluation of their potential synergistic effects or differences in efficacy for managing DM (Bhatt et al., 2016).

While individual studies have demonstrated the hypoglycemic properties of mangosteen peel and red betel leaf, respectively, this research fills a crucial gap by examining their combined effects. This approach is innovative as it reflects the holistic nature of traditional medicine practices, where multiple herbs are often used synergistically to enhance therapeutic outcomes (Hussain et al., 2017; Moghadamtousi et al., 2015). By conducting a comparative analysis with a control group receiving conventional treatment, this study provides valuable insights into the relative effectiveness of herbal remedies in the context of existing DM management strategies (Aizat et al., 2019; Ratwita et al., 2018).

Furthermore, the selection of respondents from Puskesmas Siulak Gedang adds a community-based dimension to the research, emphasizing the relevance of these herbal treatments in local healthcare practices. By engaging with DM patients undergoing routine check-ups, the study ensures a direct application of its findings to the target population, fostering a more holistic approach to diabetes management in the region.

Method

This study employed a Quasi-Experimental Design involving three respondent groups. The population consisted of all DM patients seeking treatment at Puskesmas Siulak Gedang. The sample size for this study was 24 individuals, divided into three groups: the mangosteen peel intervention group, the red betel leaf intervention group, and the control group. The inclusion criteria encompassed all patients consuming hyperglycemia medications, while exclusion criteria included severely ill patients requiring referral to a hospital.

Prior to commencing the research, the researchers obtained informed consent from the respondents by having them sign an informed consent letter. The study spanned 7 days, with interventions administered once daily. Before the study, all patients' blood sugar levels were checked using a gluco check to ensure that they were indeed hyperglycemic.

Mangosteen fruit peel was combined with water in a 1:1 ratio (w/w), i.e., 150 grams of mangosteen fruit peel mixed with 150 grams of water. This mixture was then blended to produce mangosteen fruit peel juice, separated from the fruit itself. The juice was consumed once daily for 7 days. Red betel leaves, typically three mature leaves, were boiled in 300 ml of water. Each respondent was provided with 120 ml of the resulting infusion to be consumed, cooled, once a day for 7 days.

On the 8th day, blood sugar levels of the patients were reexamined. The research findings were presented using frequency distribution, paired t-tests, and ANOVA to assess differences in the average blood sugar levels among the groups.

Result and Discussion

Univariate Analysis

Table 1. Mean Blood Sugar Levels in the Intervention Group after Receiving Red Betel Leaf Infusion, Mangosteen and Drug

Post Test Red Betel	190.75	5.701	185-200	8
Post-Test Mangosteen	194.38	8.017	184-209	8
Post-Test Drug	186.50	23.976	151-236	8

Bivariate Analysis

Table 2. The Influence of Red Betel Leaf Infusion, Mangosteen, and Drug on Blood Sugar Level Reduction

Variable	Mean	Standard Deviation	Confidence Interval of the Difference		t	df	Sig	N
			Lower	Variable				
Pre Test-Post Test Red Betel	205.000	95.064	125.525	284.475	6.099	7	0.000	8
Pre Test-Post Test Mangosteen	119.750	47.274	80.228	159.272	7.165	7	0.000	8
Pre Test-Post Test Drug	209.375	80.630	141.967	276.783	7.345	7	0.000	8

Table 3. Comparison of Red Betel Leaf and Mangosteen Peel on Blood Sugar Levels in Type II Diabetes Mellitus Patients in the Siulak Gedang Public Health Center's Service Area in 2022

	Sum of Squares	df	Mean Square	f	Sig.
Between Groups	248.583	2	124.292	0.555	0.582
Within Groups	4701.375	21	223.875		
Total	4949.958	23			

Based on Table 1, it can be observed that after medication administration (Post-Test), the average blood sugar level of the respondents was 186.50 mg/dL. Following medication, the minimum blood sugar level recorded was 151 mg/dL, and the maximum was 236 mg/dL, with a standard deviation of 23.976, among Type II diabetes mellitus patients in the Siulak Gedang Public Health Center's service area in Kerinci in 2022.

The research findings reveal that before receiving red betel leaf infusion (Pre-Test), the average blood sugar level of the respondents was 395.75 mg/dL. Prior to red betel leaf infusion, the minimum blood sugar level recorded was 259 mg/dL, and the maximum was 572 mg/dL, with a standard deviation of 98.358, among Type II diabetes mellitus patients in the Siulak Gedang Public Health Center's service area in Kerinci in 2022.

These findings align with a study conducted by Wati et al. (2020) on the impact of red betel leaf decoction therapy on blood sugar level reduction among diabetes mellitus patients in the Rejosari Village of Pekanbaru City. The study found an average blood sugar level of 260 mg/dL before the administration of red betel leaf infusion (Wati et al., 2020). After receiving red betel leaf infusion, the average blood sugar level decreased to 215.3 mg/dL.

Similarly, the research by Laili (2020) on the influence of mangosteen peel consumption on blood sugar levels among Type II diabetes mellitus patients in the Satrean Village found an average blood sugar level of 260.62 mg/dL before mangosteen peel consumption. After receiving mangosteen peel, the average blood sugar level decreased to 251.83 mg/dL.

Blood sugar levels refer to the concentration of glucose in the bloodstream (Marinda et al., 2016). Glucose transported through the blood serves as the primary energy source for body cells (Oktorina et al., 2022). Blood sugar levels are regulated by the When glucose concentration decreases due to its utilization for energy needs, the pancreas releases glucagon, and cells convert glycogen into glucose in a process called glycogenolysis (Yadav et al., 2020). Glucose is then released into the bloodstream, leading to an increase in blood sugar levels. Conversely, if blood sugar levels rise due to glycogen changes, insulin is released from granular cells, causing the liver to convert more glucose into glycogen (Galicia-Garcia et al., 2020).

Based on these research findings, it can be inferred that before receiving red betel leaf infusion, the average blood glucose levels of the patients were high. This can be attributed to poor dietary habits characterized by elevated blood glucose levels (>200 mg/dL), influenced by factors such as age, dietary patterns, lack of physical activity, and an unhealthy lifestyle (Kusmayadi et al., 2023)

Based on the research results, it can be observed that after receiving mangosteen peel juice (Post-Test), the average blood sugar level of the respondents was 194.38 mg/dL. Following the consumption of mangosteen peel juice, the minimum blood sugar level recorded was 184 mg/dL, and the maximum was 209 mg/dL, with a standard deviation of 8.017, among Type II diabetes mellitus patients in the Siulak Gedang Public Health Center's service area in Kerinci in 2022.

These research findings align with a study conducted by Laili et al. (2020) on the Influence of Mangosteen Peel Extract (Gracinia Mangostana) on Blood Sugar Levels in Diabetes Mellitus Patients in the Satrean Village, Maron Probolinggo. The study found that the respondents had an average blood sugar level of 251.83 mg/dL after receiving conventional therapy in the form of mangosteen peel extract. These results indicate a decrease in the average blood sugar level of the respondents compared to the average blood sugar level before mangosteen peel consumption, which was 260.33 mg/dL.

From the research findings, it can be assumed that after consuming mangosteen peel juice, there was a reduction in the average blood sugar level among the respondents. This reduction can be attributed to the ability of mangosteen peel juice to regulate blood sugar levels in diabetes mellitus patients. The decrease in blood sugar levels in the respondents' bodies is due to the presence of xanthones and anthocyanins in mangosteen peel, which function as antioxidants and antidiabetic agents, thereby capable of lowering blood sugar levels (Agustikawati et al., 2021; Farhan et al., 2023)

Conclusion

Based on the research findings, it can be concluded that both mangosteen peel and red betel leaf show promising potential in reducing blood sugar levels. However, it's crucial to emphasize that effective blood sugar reduction should be accompanied by maintaining a healthy dietary regimen. Recommendations include encouraging healthcare professionals to educate diabetes mellitus (DM) patients on the importance of adhering to DM medication, adopting a balanced diet, and exploring the use of mangosteen peel and red betel leaf as alternative approaches to blood sugar management. This multifaceted approach not only enhances the effectiveness of blood sugar control but also empowers DM patients to take charge of their health and well-being.

Author Contributions
Conceptualization, P.D. and W.S.; methodology, G.E.; software, G.E.; validation, P.D.; formal analysis, W.S.; investigation, P.D.; resources, W.S.; data curation, G.E; writing—original draft preparation, P.D.; writing—review and editing, W.S; visualization, P.D.; supervision, P.D.; project administration, G.E; funding acquisition, P.D. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest
The authors declare no conflict of interest.

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