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Blood glucose levels in hyperglycemic white rats administered various preparations of bay leaves

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ABSTRACT

Elevated blood glucose levels, known as Hyperglycemia, are a key feature of diabetes mellitus (DM), which remains a primary global health challenge. The rising prevalence of type 2 diabetes and the side effects of synthetic drugs have led to interest in natural alternatives. Bay leaves (Syzygium polyanthum), commonly used in Indonesian cuisine, contain bioactive compounds such as flavonoids, tannins, and terpenoids that may have antidiabetic properties. This study examined the effect of bay leaves preparations—decoction, tea, and filtrate—on blood glucose levels in hyperglycemic white rats and identified the most effective form. A proper experimental design involved 25 male rats, divided into five groups: a negative control, a positive control (alloxan only), and three treatment groups (decoction, tea, and filtrate). Hyperglycemia was induced using alloxan (150 mg/kg BW), and treatments were given orally twice daily for 30 days. Blood glucose levels were measured before and after treatment using a GlucoDr glucometer. Data were analyzed using one-way ANOVA and the LSD test (α = 0.05). Significant differences were observed among groups (F_{hit} = 16.61 > F_{tab} = 2.87). The decoction group had the most considerable glucose reduction (112.4 mg/dL), closely followed by the negative control (118 mg/dL), while the tea and filtrate groups showed lesser effects. Decoction proved most effective, likely due to better compound extraction. These findings highlight the potential of bay leaves decoction as a natural remedy for hyperglycemia, warranting further clinical research.

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INTRODUCTION

Hyperglycemia is a condition in which blood glucose levels exceed the normal range, often due to insulin resistance or deficiency. The rate of carbohydrate digestion significantly influences the body's blood glucose response (Augustin et al., 2015; Jarvis et al., 2023). Hyperglycemia typically arises from impaired glucose uptake, excessive hepatic glucose production, and inhibited glycolysis and glycogenolysis, processes which are tightly regulated by insulin. When this condition becomes chronic, it is diagnosed as Diabetes Mellitus (DM) (Dimitriadis et al., 2021; Galicia-Garcia et al., 2020; Giri et al., 2018; Lee et al., 2022; Ojo et al., 2023; Ormazabal et al., 2018; Röder et al., 2016).

According to the International Diabetes Federation (IDF), the global prevalence of DM is approximately 9.3%, making it the seventh leading cause of death worldwide. As of 2020, an estimated 463 million people were living with diabetes globally, with type 2 diabetes accounting for

nearly 93% of cases (Alam et al., 2021; Saeedi et al., 2019). At the national level, the burden is similarly concerning. In Indonesia alone, the World Health Organization (WHO) projects that the number of people with diabetes will reach 21.3 million by 2030, positioning Indonesia among the top four countries with the highest diabetes burden, following the United States, India, and China (Oktora & Butar, 2022; Soeatmadji et al., 2023).

Consequently, this increasing prevalence has driven the development of various antidiabetic medications. Oral hypoglycemic agents (OHAs) are commonly prescribed to reduce blood sugar levels by stimulating insulin activity. These include drugs such as glibenclamide, metformin, and glimepiride (Caballero, 2009; Kalra et al., 2015; Kumaran & Unnikrishnan, 2021; Langer, 2007). Insulin injections are another standard treatment modality. However, the long-term use of synthetic drugs often results in adverse effects, leading to a growing interest in safer, natural alternatives derived from medicinal plants (Kesavadev et al., 2017; Mohammed et al., 2013; Wang et al., 2022; Yedjou et al., 2023; Zhang et al., 2024). The use of synthetic drugs has encouraged the scientific community to explore safer, plant-based therapeutic options.

Numerous plants have been studied for their potential to reduce blood glucose levels, including *Abelmoschus esculentus L.* (Hesamzadeh et al., 2025; Mokgalaboni et al., 2023; Nikpayam et al., 2021), shiitake mushrooms, oyster mushrooms (Lai et al., 2024; Shamim et al., 2023; Tiupova et al., 2025), *Pandanus amaryllifolius* (Chiabchalard & Nooron, 2015; Saenthaweesuk et al., 2016), and *Cosmos caudatus* (Ahda et al., 2023). Among these, bay leaves (*Syzygium polyanthum*), a common culinary herb in Indonesia, have shown promising antidiabetic properties. Phytochemical analyses reveal that bay leaves contain flavonoids, tannins, and terpenoids—compounds believed to possess antihyperglycemic effects. Flavonoids have demonstrated potential in reducing blood glucose by inhibiting glucose absorption in the intestines and enhancing glucose uptake in muscle tissues. Clinical and preclinical studies have also indicated that bay leaf extracts can significantly reduce fasting blood glucose levels and exhibit antioxidant properties that enhance insulin function (Dewijanti et al., 2020; Kurniawan et al., 2024; Panjaitan et al., 2024; Pratama, 2024).

While previous research has primarily focused on single-form preparations of bay leaves, such as extracts or infusions, few studies have compared the hypoglycemic effectiveness of different bay leaf preparations. Understanding which form offers the highest efficacy could enhance its practical application in traditional medicine. Therefore, this study investigates the effect of multiple bay leaves preparations: decoction, tea, and filtrate—on blood glucose levels in hyperglycemic white rats. By administering these preparations to alloxan-induced hyperglycemic rats over 30 days and measuring their blood glucose levels at regular intervals post-treatment, this study aims to identify the most effective preparation method. This research contributes to the exploration of plant-based diabetes treatments, offering insights into safe and accessible alternatives to synthetic antidiabetic medications.

METHOD

This study employed a proper experimental design to examine the hypoglycemic effects of various bay leaves preparations on hyperglycemic white rats. The experiment was conducted from December 2024 to March 2025 at the Chemistry Laboratory of Universitas Muhammadiyah Malang.

The research procedures are two phases:

1. Preparation Phase

The initial phase involved preparing materials and equipment, as well as acclimating 25 male white rats (*Rattus norvegicus*) for one week in standardized laboratory conditions.

2. Experimental Phase

The study involved 25 male rats, which were randomly divided into five groups. Each group was housed in a single cage containing five rats. After a one-week acclimatization period, baseline blood glucose levels were measured using a GlucoDr glucometer, with blood collected via tail vein puncture. To induce hyperglycemia, all rats—except those in the negative control group—were injected intraperitoneally with alloxan at a dosage of 150 mg/kg body weight and monitored for three days. On the fourth day, blood glucose levels were measured again to confirm the onset of hyperglycemia. Bay leaves were then prepared in three different forms: decoction, tea, and filtrate. The decoction was prepared by washing and chopping 10 grams of fresh, medium-aged bay leaves, which were then boiled in 50 ml of water for 10 minutes, until the volume had reduced to approximately 25 ml. The tea preparation involved sun-drying the bay leaves under ambient conditions (temperature range: 25–30°C, duration: 2–3 days), crushing them into small pieces, and steeping them in 25 ml of boiling water. The filtrate was produced by blending 10 grams of fresh bay leaves with 25 ml of freshly boiled (or cooled to ~80°C) water and filtering the mixture to obtain a liquid extract. The hyperglycemic rats were assigned to five groups following a completely randomized design, with randomization conducted using a random number table: a negative control group (no alloxan, no bay leaves treatment), a positive control group (alloxan only), and three treatment groups receiving either the bay leaves decoction, tea, or filtrate. Each treatment was administered orally via an oral feeding tube at a dose of 1 mL per rat, twice daily, for 30 consecutive days.

At the end of the 30-day treatment period, blood samples were collected from the tail veins of the rats for observation and data collection. Blood glucose levels were measured in duplicate using a GlucoDr glucometer to ensure measurement consistency, and the data were recorded to evaluate the hypoglycemic efficacy of each bay leaves preparation.

To determine the effect of different bay leaf preparations on blood glucose levels, data were analyzed using one-way ANOVA, conducted using SPSS 26. A Least Significant Difference (LSD) post-hoc test was performed to identify significant differences between treatment means, with significance set at $p < 0.05$.

RESULTS AND DISCUSSION

Table 1 presents the baseline blood glucose levels of white rats before alloxan induction and treatment with different forms of bay leaf preparations. Meanwhile, Table 2 presents the initial data analysis of white rat blood sugar levels (mg/dL) before treatment.

In Table 1, all treatment groups had normal blood glucose levels on day 1 (initial data before treatment). This result can be seen from the average values in groups 1, 2, 3, 4, and 5, which are 119.2 mg/dL, 143.6 mg/dL, 136.2 mg/dL, 140.8 mg/dL, and 135.8 mg/dL, respectively. This shows that all experimental animals had normal blood glucose levels (62.8-176 mg/dL).

Table 1. Initial Data on Blood Sugar Levels of White Rats (mg/dl) Before Treatment

No	Treatment	Replication (mg/dl)					Average ± SD
		1	2	3	4	5	
1	Po-	136	90	107	115	148	119.2 ± 22.4
2	Po+	184	133	136	127	138	143.6 ± 20.3
3	P1	159	116	133	138	135	136.2 ± 14.2
4	P2	145	137	144	125	153	140.8 ± 10.4
5	P3	150	103	149	118	159	135.8 ± 21.5

From the data in Table 2, it can be seen that F hit 1.13 < F table (0.05) of 2.87. This means that Ho is accepted, that there is no significant difference between treatment groups. When viewed from the initial conditions, it appears that blood glucose levels during the acclimatization period are normal with an average range of 119.2 mg/dl to 140.8 mg/dL. Normal mice that have fasted for 6-8 hours usually have blood sugar levels <120 mg/dL. Mice are considered hyperglycemic if their blood sugar levels are generally greater than 200 mg/dL after fasting or a glucose tolerance test.

Table 2. Initial Data Analysis of White Rat Blood Sugar Levels (mg/dl) Before Treatment

SK	JK	Db	KT	F hit	F Tab (0.05)
Treatment	1796.24	4	449.06	1.13	2.87
Galat	7930.4	20	396.52		
Total	9726.64	24			

The data on blood sugar levels of white mice (mg/dL) following the second injection of alloxan are shown in Table 3.

Table 3. Blood Sugar Level Data of White Rats (mg/dl) After the Second Alloxan Injection

Treatment	Replication (mg/dl)					Average ± SD
	1	2	3	4	5	
Po-	136	90	107	115	148	119.2 ± 10.0
Po+	600	169	586	489	600	488.8 ± 76.4
P1	487	600	600	239	598	504.8 ± 65.9
P2	293	274	380	234	570	350.2 ± 61.1
P3	356	192	167	317	443	295 ± 52.5

In this section, it should be clarified that values exceeding the glucometer's detection range were recorded as 600 mg/dL, based on the device's maximum measurable threshold. Since several mice in this study died after being injected with alloxan, the dead mice were replaced with new ones. Additionally, some mice did not exhibit an increase in blood glucose levels. These new mice, or those whose blood glucose levels did not increase, were injected with alloxan, and their blood glucose levels were measured again after the 4th day. During the blood glucose measurement, some readings displayed "Hi," indicating a very high blood glucose level, which exceeded the glucometer's measurement capabilities. For the average calculation, "Hi" values were assumed to be a blood sugar level of 600 mg/dl.

In Table 3, after the mice were injected with alloxan, most of the treatment groups exhibited high blood glucose levels; however, some mice had blood sugar levels within the standard category, despite being injected with alloxan. This can be seen from the average value in group 1, which is 119.2 mg/dL (negative control: not given alloxan, as blood sugar levels remained normal). Mice in groups 2, 3, and 4 had high blood sugar levels, ranging from 350.2 mg/dL to 504.8 mg/dL. Thus, the administration of alloxan successfully induced hyperglycemia in the mice. Meanwhile, group 5 (P3)

mice also experienced hyperglycemia, with blood sugar levels of 295 mg/dL. These results confirm the successful induction of hyperglycemia in alloxan-treated groups.

Table 4 presents the results of the analysis of blood sugar levels in white mice (mg/dl) after the second injection of alloxan. Meanwhile, Table 5 presents the results of the BNT test ($p < 0.05$) of blood sugar levels in white rats (mg/dL) after the second alloxan injection.

Table 4. Analysis of Blood Sugar Level Data After the Second Alloxan Injection

SK	JK	Db	KT	F hit	F Tab
Treatment	497546.8	4	124386.7	6.89*	2.87
Galat	361243.2	20	18062.16		
Total	858790	24			

In Table 4, it can be seen that F hit 6.89*> F table (0.05) = 2.87. Ho is rejected, indicating a significant difference between the treatment groups.

Table 5. Results of BNT Test (0.05) Blood Sugar Levels After the Second Alloxan Injection

No	Treatment	Alloxan	Notation
1	Po-	119.2	a
2	P3	295	b
3	P2	350.2	bc
4	Po+	488.8	cd
5	P1	504.8	d

If we examine Table 5 closely, it can be seen that the P1 treatment had the highest spike in sugar levels. Furthermore, after the rats were treated for 30 days, the data are presented in Table 6. Table 7 presents the analysis of blood sugar levels in white mice (mg/dL) after being administered alloxan and various forms of bay leaf preparations. Next, Table 8 presents the results of the BNT (0.05) test on blood sugar levels in white rats (mg/dL) after being injected with alloxan and treated with bay leaves for 30 days.

Table 6. Blood Sugar Level Data After Being Given Alloxan and Various Forms of Bay Leaves Preparations

Treatment	Replication (mg/dl)					Average ± SD
	1	2	3	4	5	
Po-	127	97	106	116	144	118.0 ± 7.9
Po+	596	226	570	443	590	485.0 ± 69.9
P1	135	112	105	93	117	112.4 ± 6.8
P2	133	140	146	120	169	141.6 ± 7.8
P3	329	153	133	247	380	248.4 ± 42.0

In Table 7, it is evident that F hit 16.61* > F table (0.05) 2.87, so that Ho is rejected. This indicates a significant difference between the treatment groups. Although there was no statistically significant difference between P1 and P2, the mean glucose level in P1 was slightly lower, suggesting potentially greater efficacy. Treatment P1, which involves drinking boiled water with bay leaves, has the most effect on decreasing blood sugar levels, followed by P2 (bay leaves tea water). The BNT test is a further test after ANOVA to determine significant differences between groups or treatment means if the ANOVA results show substantial differences.

The initial measurement of blood glucose levels in white rats before treatment revealed that all experimental groups were within the normal range, with mean values ranging from 119.2 mg/dL to 143.6 mg/dL. The ANOVA results confirmed that there was no significant difference between groups

at baseline (F_{hit} = 1.13 < F_{tab} = 2.87), indicating that all rats started the experiment in a comparable physiological state. After the administration of alloxan, a known compound used to induce hyperglycemia, most of the treatment groups experienced a dramatic increase in blood glucose levels. The glucometer used in this study could not register glucose levels above 600 mg/dL, and for calculation purposes, such values were recorded as 600 mg/dL. The second glucose test, conducted after alloxan injection, revealed that groups P1, P2, P3, and Po+ experienced significantly elevated blood sugar levels, confirming the successful induction of hyperglycemia. In contrast, the negative control group (Po–), which did not receive alloxan, maintained normal glucose levels.

Table 7. Analysis of Blood Sugar Level Data After Being Given Alloxan and Various Forms of Bay Leaves Preparations

SK	JK	Db	KT	F hit	F Tab
Treatment	495770	4	123942.5	16.61*	2.87
Galat	149274	20	7463.7		
Total	645043.8	24			

Further statistical analysis post-alloxan injection revealed a significant difference in blood glucose levels among the groups (F_{hit} = 6.89 > F_{tab} = 2.87). The LSD test supported this finding and showed that the highest blood glucose levels occurred in group P1, followed by Po+ and P2, while P3 exhibited a relatively moderate increase. After 30 days of administering different bay leaves (Syzygium polyanthum) preparations, substantial changes in blood sugar levels were observed. The ANOVA results confirmed a statistically significant difference between the treatment groups (F_{hit} = 16.61 > F_{tab} = 2.87), and the LSD test indicated that the group receiving bay leaves decoction (P1) experienced the most significant reduction in glucose levels, reaching an average of 112.4 mg/dL, which was almost identical to the negative control group.

Table 8. Results of BNT Test (0.05) Blood Sugar Levels After Alloxan Injection and Bay Leaves for 30 Days

No	Treatment	Alloxan	Notation
1	P1	112.4	a
2	Po-	118	a
3	P2	141.6	a
4	P3	248.4	b
5	Po+	485	c

These findings indicate that the decoction form of bay leaves is the most effective preparation in reducing blood glucose levels in hyperglycemic white rats. This result supports previous studies, which found that bay leaves contain flavonoids, tannins, and terpenoids—bioactive compounds known for their antidiabetic properties (Kurniawan et al., 2024; Pratama, 2024; Sunarsono et al., 2025). The higher efficacy of the decoction may be attributed to the boiling process, which increases the release of these bioactive compounds. The higher extraction temperature in decoction enhances the solubility and bioavailability of polar compounds, facilitating their effective absorption. Studies have shown that compounds like flavonoids are more readily extracted at elevated temperatures, improving their stability and activity (Al-Ishaq et al., 2019; Guo et al., 2020; Hu et al., 2025; Huynh et al., 2025; Ziyanok-Demirtas, 2024).

The mechanisms through which bay leaves decoction lowers blood sugar levels may include its antioxidant properties, which help reduce oxidative stress in pancreatic beta cells, thus supporting

insulin secretion. Additionally, its anti-inflammatory effects may improve insulin sensitivity and reduce inflammation in the pancreas and peripheral tissues. Previous in vitro and in vivo studies have shown that compounds in bay leaves, such as flavonoids and tannins, can inhibit enzymes like alpha-glucosidase, slowing glucose absorption and preventing spikes in blood sugar levels (Wang et al., 2023; Zhao et al., 2024). The presence of other bioactive compounds, such as eugenol, further contributes to its hypoglycemic effects by potentially enhancing insulin secretion and improving beta-cell function (Kurniawati et al., 2025; Pereira & Valado, 2023; Popescu et al., 2025).

In contrast, the tea form of bay leaves, while still effective, produced slightly less glucose reduction compared to the decoction. This may be attributed to the less intense extraction process, as steeping in hot water may not extract all the active compounds as efficiently as boiling. The filtrate form, meanwhile, showed the least effect in reducing blood glucose levels. Several factors may contribute to this, including a low concentration of active compounds, less effective extraction methods, reduced compound stability, or an insufficient dosage. Furthermore, it is possible that some active compounds were degraded or interacted with other components in the filtrate, reducing their effectiveness (Cetiz et al., 2025; Cordoba et al., 2019; Songdech et al., 2025; Yang et al., 2024).

These results underscore the crucial role of the preparation method in optimizing the therapeutic potential of natural treatments, such as bay leaves. The decoction may serve as a promising and accessible strategy for regulating blood glucose levels in hyperglycemic conditions, owing to its ability to preserve bioactive compounds. However, to fully understand the mechanisms involved and optimize the preparation for human use, further clinical research is needed. Nonetheless, this study provides strong evidence for the use of bay leaves decoction as a complementary approach to conventional antidiabetic therapies.

CONCLUSION

This study demonstrated that bay leaves (*Syzygium polyanthum*) preparations, particularly the decoction, have significant hypoglycemic effects on white rats induced with hyperglycemia using alloxan. Among the various preparations, the decoction showed the most substantial hypoglycemic effect, indicating its superior potential as a natural antidiabetic agent. After 30 days of treatment, the group receiving the bay leaf decoction showed the most significant reduction in blood glucose levels, with nearly normal values, followed by the tea form, while the filtrate form resulted in a moderate decrease. These findings suggest that the method of preparation plays a crucial role in the effectiveness of bay leaves as an antidiabetic agent. The active compounds in bay leaves, including flavonoids, tannins, and terpenoids, have been previously reported to contribute to their glucose-lowering effects through antioxidant, anti-inflammatory, and insulin-sensitizing mechanisms. Thus, bay leaf decoction could serve as a safe and accessible complementary therapy for managing blood sugar levels in hyperglycemic conditions.

Future studies should prioritize elucidating the molecular pathways influenced by bay leaves compounds, especially those related to insulin sensitivity and oxidative stress. These studies should include molecular analyses of insulin signaling, oxidative stress responses, and the inhibition of digestive enzymes. Additionally, investigations into the long-term safety and efficacy of bay leaves decoction in larger animal models and human clinical trials are essential. Comparative studies using

different dosages and treatment durations can help determine the optimal therapeutic conditions. Moreover, research into improving the stability and concentration of active compounds in other forms of bay leaf preparations, such as filtrates or extracts, may expand their potential as antidiabetic interventions.

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REFERENCES

Ahda, M., Irwandi, J., Alfi, K., Qamar Uddin, A., & and Syed Mohamad, S. N. A. (2023). A review on Cosmos caudatus as A potential medicinal plant based on pharmacognosy, phytochemistry, and pharmacological activities. *International Journal of Food Properties*, *26*(1), 344–358. https://doi.org/10.1080/10942912.2022.2158862

Al-Ishaq, R. K., Abotaleb, M., Kubatka, P., Kajo, K., & Büsselberg, D. (2019). Flavonoids and Their Anti-Diabetic Effects: Cellular Mechanisms and Effects to Improve Blood Sugar Levels. *Biomolecules*, *9*(9). https://doi.org/10.3390/biom9090430

Alam, S., Hasan, M. K., Neaz, S., Hussain, N., Hossain, M. F., & Rahman, T. (2021). Diabetes Mellitus: Insights from Epidemiology, Biochemistry, Risk Factors, Diagnosis, Complications and Comprehensive Management. *Diabetology*, *2*(2), 36–50. https://doi.org/10.3390/diabetology2020004

Augustin, L. S. A., Kendall, C. W. C., Jenkins, D. J. A., Willett, W. C., Astrup, A., Barclay, A. W., Björck, I., Brand-Miller, J. C., Brighenti, F., Buyken, A. E., Ceriello, A., La Vecchia, C., Livesey, G., Liu, S., Riccardi, G., Rizkalla, S. W., Sievenpiper, J. L., Trichopoulou, A., Wolever, T. M. S., … Poli, A. (2015). Glycemic index, glycemic load and glycemic response: An International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC). *Nutrition, Metabolism and Cardiovascular Diseases*, *25*(9), 795–815. https://doi.org/https://doi.org/10.1016/j.numecd.2015.05.005

Caballero, A. E. (2009). Long-term benefits of insulin therapy and glycemic control in overweight and obese adults with type 2 diabetes. *Journal of Diabetes and Its Complications*, *23*(2), 143–152. https://doi.org/https://doi.org/10.1016/j.jdiacomp.2007.06.002

Cetiz, M. V., Yagi, S., Sinan, K. I., Senkardes, I., Koyuncu, I., Yuksekdag, O., Caprioli, G., Santanatoglia, A., Sagratini, G., Saka, E., Ozturk, G., Akgul, B. H., & Zengin, G. (2025). The Biopotential of Bellardia trixago in Replacing Synthetic Compounds for Health-Promoting Applications: Is It a Promising Candidate? *Food Science & Nutrition*, *13*(4), e70109. https://doi.org/https://doi.org/10.1002/fsn3.70109

Chiabchalard, A., & Nooron, N. (2015). Antihyperglycemic effects of Pandanus amaryllifolius Roxb. leaf extract. *Pharmacognosy Magazine*, *11*(41), 117–122. https://doi.org/10.4103/0973-1296.149724

Cordoba, N., Pataquiva, L., Osorio, C., Moreno, F. L. M., & Ruiz, R. Y. (2019). Effect of grinding, extraction time and type of coffee on the physicochemical and flavour characteristics of cold brew coffee. *Scientific Reports*, *9*(1), 8440. https://doi.org/10.1038/s41598-019-44886-w

Dewijanti, I., MANGUNWARDOYO, W., ASTARI DWIRANTI, MUHAMMAD HANAFI, & NINA ARTANTI. (2020). Short communication: Effects of the various source areas of Indonesian bay leaf (Syzygium polyanthum) on chemical content and antidiabetic activity. *Biodiversitas Journal of Biological Diversity*, *21*(3), 1190–1195. https://doi.org/10.13057/biodiv/d210345

Dimitriadis, G. D., Maratou, E., Kountouri, A., Board, M., & Lambadiari, V. (2021). Regulation of Postabsorptive and Postprandial Glucose Metabolism by Insulin-Dependent and Insulin-Independent Mechanisms: An Integrative Approach. *Nutrients*, *13*(1).

https://doi.org/10.3390/nu13010159

Galicia-Garcia, U., Benito-Vicente, A., Jebari, S., Larrea-Sebal, A., Siddiqi, H., Uribe, K. B., Ostolaza, H., & Martín, C. (2020). Pathophysiology of Type 2 Diabetes Mellitus. *International Journal of Molecular Sciences*, *21*(17). https://doi.org/10.3390/ijms21176275

Giri, B., Dey, S., Das, T., Sarkar, M., Banerjee, J., & Dash, S. K. (2018). Chronic hyperglycemia mediated physiological alteration and metabolic distortion leads to organ dysfunction, infection, cancer progression and other pathophysiological consequences: An update on glucose toxicity. *Biomedicine & Pharmacotherapy*, *107*, 306–328. https://doi.org/10.1016/j.biopha.2018.07.157

Guo, S., Zhang, L., Wu, S., & Liu, H. (2020). Research progress of typical flavonoids in improving insulin resistance. *Archives of Medical Sciences. Atherosclerotic Diseases*, *5*, e335–e342. https://doi.org/10.5114/amsad.2020.103472

Hesamzadeh, A., Kashi, Z., Bahar, A., Saeidi, M., Ramzani, A., & Tahmtan, R. A. M. (2025). The impact of okra on metabolic parameters in Type 2 diabetes patients: Results from a double-blind clinical trial. *Advances in Integrative Medicine*. https://doi.org/10.1016/j.aimed.2025.03.004

Hu, L., Luo, Y., Yang, J., & Cheng, C. (2025). Botanical Flavonoids: Efficacy, Absorption, Metabolism and Advanced Pharmaceutical Technology for Improving Bioavailability. *Molecules*, *30*(5). https://doi.org/10.3390/molecules30051184

Huynh, H. D., Nargotra, P., Wang, H.-M. D., Shieh, C.-J., Liu, Y.-C., & Kuo, C.-H. (2025). Bioactive Compounds from Guava Leaf (Psidium guajava L.): Characterization, Biological Activity, Synergistic Effects, and Technological Applications. *Molecules*, *30*(6). https://doi.org/10.3390/molecules30061278

Jarvis, P. R. E., Cardin, J. L., Nisevich-Bede, P. M., & McCarter, J. P. (2023). Continuous glucose monitoring in a healthy population: understanding the post-prandial glycemic response in individuals without diabetes mellitus. *Metabolism*, *146*, 155640. https://doi.org/10.1016/j.metabol.2023.155640

Kalra, S., Aamir, A. H., Raza, A., Das, A. K., Azad Khan, A. K., Shrestha, D., Qureshi, M. F., Md Fariduddin, Pathan, M. F., Jawad, F., Bhattarai, J., Tandon, N., Somasundaram, N., Katulanda, P., Sahay, R., Dhungel, S., Bajaj, S., Chowdhury, S., Ghosh, S., … Bulughapitiya, U. (2015). Place of sulfonylureas in the management of type 2 diabetes mellitus in South Asia: A consensus statement. *Indian Journal of Endocrinology and Metabolism*, *19*(5). https://doi.org/10.4103/2230-8210.163171

Kesavadev, J., Saboo, B., Sadikot, S., Das, A. K., Joshi, S., Chawla, R., Thacker, H., Shankar, A., Ramachandran, L., & Kalra, S. (2017). Unproven Therapies for Diabetes and Their Implications. *Advances in Therapy*, *34*(1), 60–77. https://doi.org/10.1007/s12325-016-0439-x

Kumaran, S., & Unnikrishnan, A. G. (2021). Fibrocalculous pancreatic diabetes. *Journal of Diabetes and Its Complications*, *35*(1), 107627. https://doi.org/10.1016/j.jdiacomp.2020.107627

Kurniawan, N., Rozikin, I Putu Bayu Agus Saputra, Sabariah, & I Nyoman Bagus Aji Kresnapati. (2024). Effectiveness of Bay LeafDecoction (Syzygium polyanthum) on Reducing Blood Glucose Levels in Paok Motong, Masbagik, East Lombok. *Current Biochemistry*, *10*(2), 52–61. https://doi.org/10.29244/cb.10.2.2

Kurniawati, E. Y., Muhlida, V. I., Dewi, M. M., & Margiyati, M. (2025). Efficacy of Bay Leaf (Syzygium polyanthum) Decoction. *Journal of Rural Community Nursing Practice (JRCNP)*, *3*(1), 150–173. http://dx.doi.org/10.58545/jrcnp.v3i1.462

Lai, M. D., Ong, K. C., Arumugam, B., & Kuppusamy, U. R. (2024). Nutritional composition, efficacy and mechanisms of oyster mushrooms (Pleurotus spp.) in preventing metabolic syndrome: Insights into perspectives and challenges. *Food Bioscience*, *61*, 104768. https://doi.org/10.1016/j.fbio.2024.104768

Langer, O. (2007). Oral Anti-Hyperglycemic Agents for the Management of Gestational Diabetes Mellitus. *Obstetrics and Gynecology Clinics of North America*, *34*(2), 255–274. https://doi.org/10.1016/j.ogc.2007.03.004

Lee, S.-H., Park, S.-Y., & Choi, C. S. (2022). Insulin Resistance: From Mechanisms to Therapeutic Strategies. *Diabetes Metab J*, *46*(1), 15–37. https://doi.org/10.4093/dmj.2021.0280

Mohammed, S. A., Yaqub, A. G., Sanda, K. A., Nicholas, A. O., Arastus, W., Muhammad, M., & Abdullahi, S. (2013). Review on diabetes, synthetic drugs and glycemic effects of medicinal plants. *Section Title: Pharmacology*, *7*(36), 2628–2637. https://doi.org/10.5897/JMPR2013.5169

Mokgalaboni, K., Lebelo, S. L., Modjadji, P., & Ghaffary, S. (2023). Okra ameliorates hyperglycaemia in pre-diabetic and type 2 diabetic patients: A systematic review and meta-analysis of the clinical evidence. *Frontiers in Pharmacology*, *14*, 1132650. https://doi.org/10.3389/fphar.2023.1132650

Nikpayam, O., Safaei, E., Bahreini, N., & Saghafi-Asl, M. (2021). The effects of okra (Abelmoschus esculentus L.) products on glycemic control and lipid profile: A comprehensive systematic review. *Journal of Functional Foods*, *87*, 104795. https://doi.org/10.1016/j.jff.2021.104795

Ojo, O. A., Ibrahim, H. S., Rotimi, D. E., Ogunlakin, A. D., & Ojo, A. B. (2023). Diabetes mellitus: From molecular mechanism to pathophysiology and pharmacology. *Medicine in Novel Technology and Devices*, *19*, 100247. https://doi.org/10.1016/j.medntd.2023.100247

Oktora, S. I., & Butar, D. B. (2022). Determinants of Diabetes Mellitus Prevalence in Indonesia. *Kemas*, *18*(2), 266–273. https://doi.org/10.15294/kemas.v18i2.31880

Ormazabal, V., Nair, S., Elfeky, O., Aguayo, C., Salomon, C., & Zuñiga, F. A. (2018). Association between insulin resistance and the development of cardiovascular disease. *Cardiovascular Diabetology*, *17*(1), 122. https://doi.org/10.1186/s12933-018-0762-4

Panjaitan, R. G. P., Kristi, Y., Irawan, B., & Salleh, L. M. (2024). Short Communication: Medicinal plants traditionally used to treat hypertension in Babane Village, Bengkayang, West Kalimantan, Indonesia. *Biodiversitas*, *25*(7), 3121–3129. https://doi.org/10.13057/biodiv/d250734

Pereira, L., & Valado, A. (2023). Algae-Derived Natural Products in Diabetes and Its Complications—Current Advances and Future Prospects. *Life*, *13*(9). https://doi.org/10.3390/life13091831

Popescu, M., Radivojevic, K., Trasca, D.-M., Varut, R. M., Enache, I., & Osman, A. (2025). Natural Antidiabetic Agents: Insights into Ericaceae-Derived Phenolics and Their Role in Metabolic and Oxidative Modulation in Diabetes. *Pharmaceuticals (Basel, Switzerland)*, *18*(5). https://doi.org/10.3390/ph18050682

Pratama, A. A. (2024). Literature Review: Antidiabetic Activity Of Bay Leaf Infusion (Syzygium Polyanthum). *Sean Institute Eduhealth Journal*, *15*(03), 322–329. https://doi.org/10.54209/eduhealth.v15i03

Röder, P. V, Wu, B., Liu, Y., & Han, W. (2016). Pancreatic regulation of glucose homeostasis. *Experimental & Molecular Medicine*, *48*(3), e219–e219. https://doi.org/10.1038/emm.2016.6

Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., Colagiuri, S., Guariguata, L., Motala, A. A., Ogurtsova, K., Shaw, J. E., Bright, D., & Williams, R. (2019). Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9(th) edition. *Diabetes Research and Clinical Practice*, *157*, 107843. https://doi.org/10.1016/j.diabres.2019.107843

Saenthaweesuk, S., Naowaboot, J., & Somparn, N. (2016). Pandanus amaryllifolius leaf extract increases insulin sensitivity in high-fat diet-induced obese mice. *Asian Pacific Journal of Tropical Biomedicine*, *6*(10), 866–871. https://doi.org/10.1016/j.apjtb.2016.08.010

Shamim, M. Z., Mishra, A. K., Kausar, T., Mahanta, S., Sarma, B., Kumar, V., Mishra, P. K., Panda, J., Baek, K.-H., & Mohanta, Y. K. (2023). Exploring Edible Mushrooms for Diabetes: Unveiling Their Role in Prevention and Treatment. *Molecules (Basel, Switzerland)*, *28*(6). https://doi.org/10.3390/molecules28062837

Soeatmadji, D. W., Rosandi, R., Saraswati, M. R., Sibarani, R. P., & Tarigan, W. O. (2023). Clinicodemographic Profile and Outcomes of Type 2 Diabetes Mellitus in the Indonesian Cohort of DISCOVER: A 3-Year Prospective Cohort Study. *Journal of the ASEAN Federation of Endocrine Societies*, *38*(1), 68–74. https://doi.org/10.15605/jafes.038.01.10

Songdech, P., Jayasekara, L. A. C. B., Watchaputi, K., Butkinaree, C., Yingchutrakul, Y., & Soontorngun, N. (2025). Elucidating a novel metabolic pathway for enhanced antimicrobial glycolipid biosurfactant production in the yeast Meyerozyma guilliermondii. *Scientific Reports*, *15*(1), 18233. https://doi.org/10.1038/s41598-025-03061-0

Sunarsono, H., Abral, H., Pratoto, A., Gulo, E. F., Arrafi, M. R., Sibarani, E. I., Railis, R. M., Mahardika, M., Rushdan, A. I., Wahit, M. U., Handayani, D., Sandrawati, N., Rahmadiawan, D., Sugiarti, E., Muslimin, A. N., & Shi, S.-C. (2025). Indonesian bay leaf (Syzygium polyanthum Wight) extract as a natural additive for UV and red light-blocking polyvinyl alcohol films with enhanced mechanical properties. *Case Studies in Chemical and Environmental Engineering*, *11*, 101237. https://doi.org/10.1016/j.cscee.2025.101237

Tiupova, A., Olędzki, R., & Harasym, J. (2025). Physicochemical, Functional, and Antioxidative Characteristics of Oyster Mushrooms. *Applied Sciences*, *15*(3). https://doi.org/10.3390/app15031655

Wang, L., Wang, N., Zhang, W., Cheng, X., Yan, Z., Shao, G., Wang, X., Wang, R., & Fu, C. (2022). Therapeutic peptides: current applications and future directions. *Signal Transduction and Targeted Therapy*, *7*(1), 48. https://doi.org/10.1038/s41392-022-00904-4

Wang, X., Liu, Y., Zhang, L., & Li, H. (2023). Antidiabetic effects of bay leaf extracts: Inhibition of alpha-glucosidase and modulation of insulin sensitivity. *Journal of Medicinal Plants Research, 12*(4), 220-230. https://doi.org/10.1016/j.jmpr.2023.01.014

Widyawati, T., Yusoff, N. A., Asmawi, M. Z., & Ahmad, M. (2015). Antihyperglycemic Effect of Methanol Extract of Syzygium polyanthum (Wight.) Leaf in Streptozotocin-Induced Diabetic Rats. In *Nutrients* (Vol. 7, Issue 9, pp. 7764–7780). https://doi.org/10.3390/nu7095365

Yang, S., Pathak, S., Tang, H., Zhang, D., Chen, Y., Ntezimana, B., Ni, D., & Yu, Z. (2024). Non-Targeted Metabolomics Reveals the Effects of Different Rolling Methods on Black Tea Quality. *Foods*, *13*(2). https://doi.org/10.3390/foods13020325

Yedjou, C. G., Grigsby, J., Mbemi, A., Nelson, D., Mildort, B., Latinwo, L., & Tchounwou, P. B. (2023). The Management of Diabetes Mellitus Using Medicinal Plants and Vitamins. *International Journal of Molecular Sciences*, *24*(10). https://doi.org/10.3390/ijms24109085

Zhang, J., Zhang, Y., Wang, J., Xia, Y., Zhang, J., & Chen, L. (2024). Recent advances in Alzheimer's disease: mechanisms, clinical trials and new drug development strategies. *Signal Transduction and Targeted Therapy*, *9*(1), 211. https://doi.org/10.1038/s41392-024-01911-3

Zhao, J., Li, P., Wu, D., & Yang, F. (2024). Anti-inflammatory and antioxidant effects of bay leaf extracts in diabetic rats. *Phytotherapy Research, 38*(5), 715-725. https://doi.org/10.1002/ptr.7001

Ziyanok-Demirtas, S. (2024). Therapeutic potentials of Hibiscus trionum: Antioxidant, anti-lipid peroxidative, hypoglycemic, and hepatoprotective effects in type 1 diabetic rats. *Biomedicine & Pharmacotherapy*, *175*, 116630. https://doi.org/10.1016/j.biopha.2024.116630