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Literature Review: Antidiabetic Activity Of Bay Leaf Infusion (Syzygium Polyanthum)

Anggi Ayu Pratama
Pharmacy Study Program, Faculty of Health Science, Singaperbangsa Karawang University, Karawang, Indonesia

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ABSTRACT
Diabetes mellitus (DM) is a group of metabolic disorders associated with elevated blood glucose levels and is predicted to significantly increase in the next 1 or 2 decades. Given the rising global prevalence of diabetes mellitus and the long-term side effects of chemical drugs, it is important to explore effective and safe natural alternatives. Lowering blood glucose levels (hyperglycemia) can be achieved using the traditional herbal remedy of bay leaf infusion (*Syzygium polyanthum*). The aim of this review article is to provide a summary of scientific data from several trials on the antidiabetic activity of bay leaf infusion in reducing blood sugar levels and describing secondary metabolites that are effective as antidiabetic agents, which can be further developed as treatments for diabetes mellitus. The method in this study is a review article with data collection from April to May using Google Scholar, which resulted in finding 6 relevant journals. The results obtained in this review article show that bay leaf infusion is effective in reducing blood sugar levels in both animal models and patients with diabetes mellitus, with a significant value of $p<0.005$. This can occur due to the presence of secondary metabolites in bay leaves, such as flavonoids, tannins, saponins, and alkaloids, which can provide antidiabetic effects. In conclusion, there is a significant relationship between the reduction in blood sugar levels and bay leaf infusion due to the secondary metabolites present in bay leaves.

Corresponding Author:
Anggi Ayu Pratama
Singaperbangsa Karawang University
Jl. HS. Ronggo Waluyo, Paseurjaya, Telukjambe Timur
Karawang, Jawa Barat 41361
2010631210017@student.unsika.ac.id

INTRODUCTION

According to the Ministry of Health in 2020, global health challenges, particularly in Indonesia, are influenced by lifestyle, diet, environment, physical activity levels, and psychological stress. These factors contribute to the increasing number of cases of various diseases, including diabetes mellitus (Mierza et al., 2023). Diabetes mellitus (DM) is a metabolic disorder characterized by high blood glucose levels and abnormalities in the metabolism of carbohydrates, fats, and proteins. Type 1 DM, accounting for 5%-10% of cases, usually arises in childhood or early adulthood. This type is caused by damage to the pancreatic β-cells due to an autoimmune response, resulting in absolute insulin deficiency. The autoimmune process

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is triggered by macrophages and T lymphocytes that produce autoantibodies against β-cell antigens, including islet cell antibodies and insulin antibodies. In contrast, type 2 DM, accounting for 90% of cases, is characterized by a combination of insulin resistance and relative insulin deficiency. Insulin resistance occurs through various mechanisms, including increased lipolysis and production of free fatty acids, increased glucose production by the liver, and decreased skeletal muscle ability to absorb glucose (Nugraha & Hasanah, 2018).

The number of diabetes mellitus (DM) patients continues to increase, with an estimated rise from 171 million in 2000 to 366 million by 2030 worldwide. Diabetes mellitus is one of the metabolic diseases whose prevalence keeps increasing every year in various countries. Indonesia ranks third in the world in the number of diabetes mellitus cases (Sari N & Hisyam B, 2014). Lowering blood glucose levels (hyperglycemia) can be achieved by consuming synthetic drugs such as sulfonylureas and biguanides. In addition, the use of natural remedies can also help in managing hyperglycemia. The use of natural remedies is considered safer than synthetic drugs because they typically have lower risks of side effects (Handayani & Mahanani, 2019). Generally, many people have been using medicinal plants as an alternative traditional treatment to lower blood glucose levels. Knowledge about medicinal plants and their processing techniques is often passed down through generations as part of cultural heritage. Therefore, it is important to continue developing and conducting further research on the use of medicinal plants to gain stronger medical support (Febrina et al., 2023).

Bay leaf (*Syzygium polyanthum*) is one of the plant options that can be used as an alternative in lowering blood sugar levels. Based on the study by Hidayati et al. (2020), bay leaf is believed to have the potential to treat diabetes because it contains various types of chemical compounds such as flavonoids, alkaloids, saponins, phenols, terpenoids, and steroids. Flavonoids, one of these compounds, are believed to play a major role in anti-diabetic activity. Flavonoids found in bay leaves are categorized as compounds that can reduce blood glucose levels. The hypoglycemic mechanism is thought to be due to the ability of flavonoids to inhibit the reabsorption of glucose by the kidneys and increase the solubility of glucose in the blood, making it easier to excrete glucose through urine. Therefore, flavonoids contained in bay leaves are believed to have an effect on lowering blood glucose levels (Kartikaningrum, 2022).

The making of antidiabetic medication from bay leaves (*Syzygium polyanthum*) involves the infusion technique, which entails boiling bay leaves with water. Infusion is a liquid produced by extracting botanical materials, called crude drugs, using water at a temperature of 90˚C for 15 minutes. This process involves heating the crude drug over a water bath for 15 minutes after reaching a temperature of 90˚C, with occasional stirring. Afterwards, the crude drug is removed and strained while still hot. This infusion is produced through extraction using water as a solvent, which is polar in nature. Compounds with similar polar properties will dissolve more easily in polar solvents. Therefore, the infusion technique with bay leaves is chosen because it is effective in obtaining active compounds such as saponins, tannins, flavonoids, and alkaloids that are soluble in water. Additionally, this technique is easier to apply in communities compared to other extraction techniques (Khafidhoh et al., 2015).

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The purpose of this review article is to provide a summary of scientific data from several trials on the antidiabetic activity of bay leaf infusions in reducing blood glucose levels and describing secondary metabolites that are effective as antidiabetic agents, which can be further developed as treatments for diabetes mellitus. This review article can provide an assessment of the effectiveness of bay leaf infusion as an antidiabetic treatment that has been used for generations by presenting valid scientific evidence. Additionally, it offers insights into natural-based alternative treatments, which may have fewer side effects compared to conventional chemical medications.

METHODS

This literature research employs a review article method by searching for national publication journals through databases such as Google Scholar. The keywords used are "antidiabetes" and "bay leaf infusion". The evaluated journals span the period from 2014 to 2024, covering 10 years, with journal collection conducted from April to May. The total number of research journals collected is 1,876. Inclusion criteria include studies discussing the antidiabetic activity of bay leaf infusion. Meanwhile, exclusion criteria include the mismatch of abstracts, results, and discussions with the research title. After the screening process, 5 journals were found to meet these criteria.

RESULTS AND DISCUSSION

Table 1. Results of Literatur Review

Researcher	Research title	Results	Statistical significance
(Kresnapati et al., 2024)	Anti-hyperglycemic Bay Leaf (*Syzygium polyanthum*) Infusion Among Worker Profiles in Paok Motong Village, Masbagik District, East Lombok	The blood sugar levels decreased significantly. The highest decrease in blood sugar was observed in the Housewives profession, at 20.42 mg/dL.	P=0,001
(Puspita et al., 2024)	Test of Antidiabetic Activity of Bay Leaf (*Syzygium polyanthum*) Infusion on Alloxan-Induced Mice	Blood glucose levels decreased at concentrations of 10%, 15%, and 20% infusions. The optimal dose is at a concentration of 20%.	P<0,005
(Sinata et al., 2023)	Testing the Antidiabetic Activity of Bay Leaf Infusion (*Syzygium polyanthum* (Wight) Walp.) Against Blood Glucose Levels in	Blood sugar levels decreased significantly at infusion concentrations of 10%, 20%, and 40%.	P=0,00

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Researcher	Research title	Results	Statistical significance
	Male White Mice (Mus Musculus L.) Induced by Glucose		
(Kartikaningrum, 2022)	Testing of Anti-hyperglycemia of Bay Leaf Infusion (*Syzygium polyanthum*) in Glucose-Induced Mice	The blood sugar levels significantly decreased at doses of 0.2 ml and 0.4 ml.	P<0,005
(Kurniawan et al., 2023)	The Influence of Bay Leaf (*Syzygium polyanthum*) Infusion on Decreasing Blood Glucose Levels in the Paok Motong Area, Masbagik District, East Lombok	Blood sugar levels decreased significantly.	P=0,001

Antidiabetic Compounds in Bay Leaves (Syzygium polyanthum)

Based on several studies listed in Table 1, bay leaves have been explored as agents to combat diabetes mellitus. Bay leaf infusion has been proven effective in significantly reducing blood glucose levels in both animal experiments and patients with diabetes mellitus. According to research conducted by Kresnapati, et al. (2024) and Kartikanungrum (2022), bay leaves contain various secondary metabolite compounds such as alkaloids, flavonoids, and tannins. Studies by Puspita, et al. (2023) and Sinata, et al. (2023) also indicate that bay leaves contain flavonoids, tannins, and saponins. Additionally, research by Kurniawan, et al. (2023) found that bay leaves contain essential oils, tannins, flavonoids, and terpenoids.

The flavonoids found in bay leaves are a type of compound capable of lowering blood glucose levels (Sinata et al., 2023). The mechanism of action of these flavonoids is by stimulating insulin secretion, which increases glucose absorption by peripheral tissues, thus reducing blood glucose levels in the bloodstream (Kresnapati et al., 2024). Several literature studies also indicate that bay leaf infusion has benefits in regulating blood glucose levels (Rissa, 2022), increasing food absorption, and controlling blood pressure. Additionally, the antioxidant content in bay leaves functions as a free radical scavenger (Kresnapati et al., 2024).

In addition to flavonoids, the reduction in blood glucose levels is also caused by other phytochemical compounds such as alkaloids found in bay leaves. Alkaloids play a role in regenerating damaged pancreatic beta cells. Moreover, alkaloid compounds in bay leaves also contribute to lowering blood glucose levels by inhibiting glucose absorption in the intestines and glucose synthesis through the inhibition of enzymes such as glucose 6-phosphatase and fructose 1,6-bisphosphatase (Kresnapati et al., 2024).

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Tannins also function as binding agents that contract the epithelial membrane layer of the small intestine, thus reducing the absorption of nutrients including glucose (Prameswari & Widjanarko, 2014). According to Mutia Rissa (2022), tannins lower blood sugar levels by stopping the action of free radicals and reducing oxidative stress in the body. The antioxidant compound tannin also acts as an inhibitor of α-glucosidase, which is useful in slowing down the absorption of glucose after meals, thereby reducing postprandial hyperglycemia conditions (Kurniawan et al., 2023).

The study by Fiana, et al. (2016), indicates that saponins work by inhibiting the activity of the α-glucosidase enzyme. This enzyme is responsible for the absorption of glucose in the small intestine, thereby reducing blood glucose levels. Saponins play a crucial role in maintaining intracellular calcium (Ca2+) concentration and Ca2+ homeostasis. Saponins also have the ability to stimulate insulin secretion from pancreatic beta cells through a mechanism similar to oral antidiabetic drugs such as sulfonylureas. This mechanism involves the inhibition of the K-ATPase channel and the prevention of potassium efflux from the cell, resulting in the depolarization of the beta cell membrane. This then opens the Ca2+-ATPase channel, allowing calcium ions to enter the cytoplasm. These calcium ions can activate the calmodulin enzyme within the cell, which induces the exocytosis of insulin from vesicles to be secreted outside the cell.

Antidiabetic Activity of Bay Leaf Infusion (Syzygium polyanthum)

Kresnapati, et al. (2024), conducted a study on the effectiveness of bay leaf infusion in reducing blood sugar levels and all the work undertaken in the Paok Motong Village. The results of the study indicated a significant correlation ($p=0.001$) between the administration of bay leaf infusion and the reduction of blood sugar levels across various occupations, with the highest decrease observed in housewives at 20.42 mg/dL and the lowest decrease in farmers at 13.79 mg/dL. Farmers tended to have higher blood sugar levels compared to other occupations, despite farming being a physically demanding job that should theoretically reduce the risk of high blood sugar levels. This phenomenon may be attributed to various factors, such as the unhealthy habits of farmers, like smoking (Suhaeni, 2022), and high sodium intake, leading to a decrease in the effectiveness of the antioxidant activity of bay leaves (Andriani et al., 2021).

Puspita, et al. (2023), conducted a study on the antidiabetic activity of bay leaf infusion in aloxan-induced mice. The results of the study indicated that bay leaf infusion has significant antidiabetic activity ($p<0.005$). The infusion groups with doses of 10%, 15%, and 20% showed reductions in blood glucose levels by 42.2%, 50.2%, and 66.6%, respectively. The decrease in blood glucose levels was observed with increasing concentrations of bay leaf infusion. The higher the concentration of bay leaf infusion, the greater the effect of lowering blood sugar. This phenomenon may be attributed to the presence of flavonoids, saponins, and tannins in the bay leaf infusion in the test groups, which led to a reduction in blood glucose levels. These compounds function as antioxidants that reduce oxidative stress by neutralizing free radicals generated from the oxidation reaction of aloxan.

Sinata, et al. (2023), conducted a study on the antidiabetic activity of bay leaf infusion in aloxan-induced mice. The results of the study indicated that bay leaf infusion has significant

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antidiabetic activity (p=0.00). Bay leaf infusion concentrations of 10%, 20%, and 40% were used, and after 30 minutes of oral glucose administration, the blood glucose levels of the mice still showed diabetic conditions. The decrease in blood glucose levels occurred at the 60th, 90th, and 120th minutes. This indicates that the bay leaf infusion in this group is effective in lowering the blood glucose levels of the mice, but the decrease remains within the normal range and does not cause hypoglycemia. The reduction in blood glucose levels in the mice caused by bay leaf infusion is influenced by the secondary metabolites present in the bay leaf infusion. The flavonoid content in bay leaves has antioxidant effects that can lower blood sugar levels. The timing variations of bay leaf infusion administration also have an impact on changes in blood glucose levels in the mice, both in increases and decreases. This provides important insights into the optimal strategy for using bay leaf infusion in regulating blood glucose levels.

Kartikanungrum, (2022) conducted a study on the anti-hyperglycemic effects of bay leaf infusion in aloxan-induced mice. The results of the study indicated that bay leaf infusion has significant antidiabetic activity (p<0.005). The doses used in this study were 0.2 ml/20 gBW and 0.4 ml/20 gBW, with average blood sugar levels decreasing by 204.5 mg/dL and 164.7 mg/dL, respectively. This research shows that bay leaf infusion is capable of lowering blood glucose levels, although the reduction has not yet reached a level considered normal. This may be due to the insufficient duration of bay leaf infusion administration; in this study, it was only administered for 7 days. Although the ability of bay leaf infusion to lower blood sugar levels is not certain, it is likely influenced by the presence of flavonoids, tannins, and alkaloids.

Kurniawan, et al. (2023), conducted a study on the antidiabetic activity of bay leaf infusion in reducing blood sugar levels in Paok Motong. The results of the study indicated that bay leaf infusion has significant antidiabetic activity with a value of significance (p=0.001). The decrease in blood sugar levels before the administration of the infusion, from 194.49 mg/dL to 179.27 mg/dL. In this study, blood sugar measurements were examined based on gender differences, revealing the most significant decrease in blood glucose levels of 17 mg/dL in males compared to a decrease of 14.35 mg/dL in females. This difference may be due to the higher level of physical activity in male respondents compared to females. Intensive physical activity can reduce the concentration of HbA1c and blood glucose by increasing muscle permeability and blood flow, thus making insulin receptors more sensitive. Additionally, considering the age differences, it was found that the most significant decrease in blood glucose levels occurred in the early adulthood age group (26-35 years), by 19.75 mg/dL. This may be due to the higher level of physical activity in this age group. The younger a person is, the higher their physical activity level, resulting in increased metabolism in the body (Noviyanti & Marfuah, 2017). High metabolism processes generate a high energy demand, and glucose is often used as the primary source of energy, leading to a decrease in blood glucose levels.

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CONCLUSION

From the results of the literature study, it can be concluded that bay leaf infusion (*Syzygium polyanthum*) has a positive effect in reducing blood glucose levels both in experimental animals and patients with diabetes mellitus. Bay leaves have antidiabetic properties because they contain flavonoid secondary metabolite compounds, which are the main components in bay leaves, stimulating insulin secretion and increasing the absorption of blood sugar by peripheral tissues, thus reducing blood glucose levels in circulation. With the findings from this literature study, bay leaf infusion can be used as an alternative in the prevention and traditional treatment of diabetes mellitus. With this review article, it is hoped that bay leaf infusion can be developed into a phytopharmaceutical for treating diabetes mellitus.

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