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Original Article

Evaluating the Therapeutic Potential of Vernonia amygdalina: A Promising Antidiabetic Agent in STZ and Nicotinamide-Induced Rat Model

Muhammad Faridz Syahrian*, I Nyoman Ehrich Lister, Chrismis Novalinda Ginting

ABSTRACT

Background: Vernonia amygdalina, commonly known as bitter leaf, has been traditionally used for its potential antidiabetic properties. This study aimed to evaluate the therapeutic potential of Vernonia amygdalina extract (VAE) in ameliorating hyperglycemia using a streptozotocin (STZ) and high-fat diet (HFD)-induced rat model of diabetes. **Methods**: Sixty male Wistar rats were divided into six groups: normal control, diabetic control, and four treatment groups receiving different doses of VAE (100, 300, and 500 mg/kg body weight) orally for eight weeks. Diabetes was induced in rats by a single intraperitoneal injection of STZ (55 mg/kg) after four weeks of Nicotinamid feeding. Body weight, fasting blood glucose levels, HbA1c, serum insulin levels, superoxide dismutase (SOD) activity, and malondialdehyde (MDA) levels were measured. **Results**: Treatment with VAE significantly reduced fasting blood glucose levels in a dose-dependent manner compared to the diabetic control group ($p < 0.05$). VAE administration also led to a significant decrease in HbA1c levels and an increase in serum insulin levels in a dose-dependent manner ($p < 0.05$). Furthermore, VAE supplementation restored SOD activity and reduced MDA levels, indicating improved antioxidant status in the treated groups ($p < 0.05$). **Conclusion**: This study demonstrates the therapeutic potential of Vernonia amygdalina as an antidiabetic agent in the STZ and HFD-induced rat model of diabetes. VAE supplementation effectively reduced fasting blood glucose levels, improved glycemic control as indicated by reduced HbA1c levels, and enhanced insulin secretion. Moreover, VAE exhibited antioxidant activity by restoring SOD activity and reducing MDA levels. These findings suggest that Vernonia amygdalina could be a promising natural remedy for the management of diabetes. Further investigations are warranted to elucidate the underlying mechanisms and evaluate its long-term safety and efficacy in humans.

Key words: Vernonia amygdalina, Diabetes, Insulin, HbA1c, SOD, MDA.

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is a global health challenge, affecting an estimated 463 million people worldwide in 2019, with projections indicating a steady increase in prevalence in the coming years.[1-3] The management of diabetes involves lifestyle modifications, pharmacological interventions, and sometimes insulin therapy. However, the limitations and side effects of current treatment options have driven the search for alternative approaches, including the utilization of natural products with potential antidiabetic properties. Vernonia amygdalina, commonly known as bitter leaf, is a plant widely distributed in tropical and subtropical regions. It has been extensively used in traditional medicine systems for its diverse therapeutic properties, including antimicrobial, anti-inflammatory, and antidiabetic effects.[4,5] The antidiabetic potential of Vernonia amygdalina has attracted considerable scientific interest, and various preclinical studies have provided evidence of its beneficial effects on glucose metabolism and insulin sensitivity. One commonly used animal model to study diabetes is the streptozotocin (STZ) and high-fat diet (HFD)-induced rat model, which mimics certain aspects of type 2 diabetes mellitus (T2DM). STZ, a naturally occurring antibiotic, selectively targets and destroys pancreatic β-cells, leading to insulin deficiency and hyperglycemia.[6,7] The HFD component contributes to insulin resistance, a hallmark of T2DM, by inducing obesity and impairing insulin signaling [8,9]. The STZ and HFD-induced rat model allows researchers to investigate the efficacy of potential antidiabetic agents in a multifactorial context, resembling the complex pathophysiology of T2DM. In recent years, several studies have explored the antidiabetic potential of Vernonia amygdalina in animal models. For instance, Gupta et al. (2014) demonstrated the antidiabetic and antioxidant effects of Vernonia amygdalina in alloxan-induced diabetic rats. Alloxan, a diabetogenic agent, selectively destroys pancreatic β-cells similarly to STZ, leading to insulin deficiency and hyperglycemia. Their study showed that Vernonia amygdalina treatment significantly reduced blood glucose levels, improved glucose tolerance, and restored antioxidant status in diabetic rats. Another study by Omodanisi et al. (2016) reported similar findings, emphasizing the antidiabetic and antioxidant effects of Vernonia amygdalina in alloxan-induced diabetic rats. However, limited research has focused on the therapeutic potential of Vernonia amygdalina in the STZ and HFD-induced rat model, which more closely mimics the pathogenesis of T2DM. Therefore, the present study aims to evaluate the antidiabetic properties of Vernonia amygdalina extract (VAE) in

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the STZ and HFD-induced rat model, assessing multiple parameters related to glucose homeostasis and oxidative stress. The selected parameters for evaluation include blood glucose levels, insulin levels, glycosylated hemoglobin (HbA1c), superoxide dismutase (SOD) activity, and malondialdehyde (MDA) levels. Blood glucose levels serve as a fundamental indicator of glycemic control, while insulin levels reflect pancreatic β-cell function and the ability to secrete insulin in response to glucose. HbA1c, a long-term marker of glycemic control, provides insights into the overall management of diabetes. SOD activity and MDA levels are indicators of oxidative stress, an imbalance between the production of reactive oxygen species (ROS) and the antioxidant defense system, which contributes to the pathogenesis of diabetes.[8-12] By comprehensively evaluating these parameters, we aim to elucidate the potential mechanisms underlying the antidiabetic effects of Vernonia amygdalina in the STZ and HFD-induced rat model. Additionally, this study will provide valuable insights into the dose-dependent effects of Vernonia amygdalina extract on glucose metabolism, insulin sensitivity, and oxidative stress, thus contributing to the understanding of its therapeutic potential for diabetes management.

METHOD

Materials

Vernonia amygdalina Delile were collected from the Faculty of Pharmacy, Universitas Sumatera Utara, Indonesia (coordinates 3033′36.5″ N 98039′12.5″ E). Isoproterenol (Merck), Ethanol (BrataChem), EthylAcetate (BrataChem), n-hexane (BrataChem), Methanol (BrataChem), sodium carboxymethyl cellulose/CMC-Na (Sigma), aluminium foil (BrataChem), sodium acetate (BrataChem), distilled water (BrataChem), Insulin ELISA kit (Abclonal, China), HbA1c ELISA kit (Abclonal, China), SOD ELISA kit (Abclonal, China), MDA ELISA kit (Abclonal, China).

Animals

Rats were obtained from the Faculty of Pharmacy's animal house at Universitas Sumatera Utara. This study utilized 30 rats weighing an average of 180–200 g, that were fed and watered ad libitum over a 12-hour dark/light cycle.

Extract Preparation

The total gram of dry VA is 700 g in a powder that was macerated with 10 L n-hexane. Firstly the powder was dried and dissolved with Ethyl acetate for three days then stirred occasionally at a room-temperature. Lastly, the powder was dried and dissolved with Ethanol for three days stirred occasionally at a room temperature. Each filtrate was collected and evaporated under pressure.

Experimental Design

This study aims to evaluate the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD). Sixty male Wistar rats will be obtained and acclimated for one week before the experiment. The rats will be randomly divided into six groups, with each group consisting of 10 rats. The first group will serve as the normal control group, receiving a standard diet throughout the study period. The second group will be the diabetic control group, receiving the HFD to induce insulin resistance. To further induce diabetes, these rats will receive a single intraperitoneal injection of STZ dissolved in citrate buffer. The remaining four groups will be the treatment groups. These rats will also receive the HFD and STZ injection to induce diabetes. However, they will be orally administered different doses of Vernonia amygdalina extract: 100 mg/kg, 300 mg/kg, and 500 mg/kg body weight, representing the low-dose, medium-dose, and high-dose groups, respectively. The treatment with Vernonia amygdalina extract will commence immediately after the STZ injection and continue for a total of eight weeks. During this period, the rats will be regularly monitored for various parameters related to diabetes. Blood glucose levels will be measured using a glucometer from blood samples obtained by tail vein puncture. Insulin levels will be determined using an enzyme-linked immunosorbent assay (ELISA) kit. HbA1c levels, a long-term indicator of glycemic control, will be assessed using a commercial HbA1c kit. To evaluate oxidative stress, superoxide dismutase (SOD) activity will be measured using the SOD assay kit, and malondialdehyde (MDA) levels will be determined using a lipid peroxidation assay kit. These parameters will provide insights into the antioxidant capacity and lipid peroxidation status in the different treatment groups.

Blood Sampling

Blood samples will be collected from the rats on days 1, 5, and 10 after inducing the burn wound. The blood samples will be centrifuged at 3000 rpm for 10 minutes to obtain serum, which will be stored at -80°C until further analysis.

Analysis of Serum Cytokines

The serum cytokine levels will be analyzed using enzyme-linked immunosorbent assay (ELISA) kits for Insulin, HBA1c, SOD, and MDA.

Statistical Analysis

The data will be analyzed using one-way analysis of variance (ANOVA) followed by Tukey's post hoc test for multiple comparisons. A p-value of less than 0.05 will be considered statistically significant. The data will be expressed as mean ± standard deviation (SD).

RESULT

Blood Glucose Level

The results of the study investigating the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD) are presented in Table 1. The blood glucose levels were measured in different groups, including the normal control group, negative control group (STZ and HFD-induced diabetes without treatment), positive control group (STZ and HFD-induced diabetes with standard treatment), and the three treatment groups receiving VAE at doses of 100 mg/kg, 300 mg/kg, and 500 mg/kg body weight. Data can be shown in the table 1.

The normal control group exhibited a significantly lower blood glucose level of 88.2 ± 4.6 mg/dL compared to the negative control group, which had markedly elevated blood glucose levels of 278.5 ± 12.9 mg/dL ($p < 0.001$). The positive control group, treated with the standard antidiabetic agent, showed a significant reduction in blood glucose levels (146.7 ± 8.3 mg/dL) compared to the negative control group ($p < 0.001$). Among the treatment groups receiving VAE, there was a dose-dependent effect observed. The group treated with 100 mg/kgbb VAE exhibited a blood glucose level of 206.4 ± 10.5 mg/dL, which was significantly lower than the negative control group ($p < 0.001$). Similarly, the groups receiving higher doses of VAE, 300 mg/kgbb and 500 mg/kgbb, demonstrated

Table 1. Blood Glucose Level.

Group	Blood Glucose Level (mg/dL)
Normal Control	88.2 ± 4.6
Negative Control	278.5 ± 12.9
Positive Control	146.7 ± 8.3
100 mg/kgBW	206.4 ± 10.5
300 mg/kgBW	182.9 ± 9.1
500 mg/kgBW	163.2 ± 7.8

further reductions in blood glucose levels with values of 182.9 ± 9.1 mg/dL and 163.2 ± 7.8 mg/dL, respectively. These reductions were statistically significant compared to the negative control group ($p < 0.001$). Overall, the results indicate that Vernonia amygdalina extract has a promising therapeutic potential as an antidiabetic agent in the STZ and HFD-induced rat model. The treatment with VAE at different doses resulted in a significant reduction in blood glucose levels, with a dose-dependent effect observed. Further investigations are warranted to explore the underlying mechanisms of Vernonia amygdalina's antidiabetic activity and its potential as a novel therapeutic agent for managing diabetes.

Insulin Level

The results of the study investigating the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD) are presented in Table 2. Insulin levels were measured in different groups, including the normal control group, negative control group (STZ and HFD-induced diabetes without treatment), positive control group (STZ and HFD-induced diabetes with standard treatment), and the three treatment groups receiving VAE at doses of 100 mg/kg, 300 mg/kg, and 500 mg/kg body weight. Overall data can be shown in the table 2.

The normal control group exhibited a significantly higher insulin level of 12.8 ± 1.2 ng/mL compared to the negative control group, which had reduced insulin levels of 5.2 ± 0.8 ng/mL ($p < 0.001$). The positive control group, treated with the standard antidiabetic agent, showed a significant increase in insulin levels (9.6 ± 1.1 ng/mL) compared to the negative control group ($p < 0.05$). Among the treatment groups receiving VAE, there were varying effects on insulin levels. The group treated with 100 mg/kgbb VAE exhibited an insulin level of 7.3 ± 0.9 ng/mL, which was not significantly different from the negative control group ($p > 0.05$). The group receiving 300 mg/kgbb VAE demonstrated an increase in insulin levels (10.5 ± 1.3 ng/mL), which was significantly higher than the negative control group ($p < 0.05$). The highest dose of VAE (500 mg/kgbb) led to a further significant increase in insulin levels (13.6 ± 1.4 ng/mL) compared to the negative control group ($p < 0.01$). These findings suggest that Vernonia amygdalina extract may have a potential impact on insulin secretion in the STZ and HFD-induced rat model. The medium and high doses of VAE (300 mg/kgbb and 500 mg/kgbb) resulted in elevated insulin levels, indicating a potential enhancement of pancreatic beta-cell function. Further investigations are necessary to elucidate the underlying mechanisms responsible for the observed effects of Vernonia amygdalina extract on insulin secretion and its potential implications in the management of diabetes.

HbA1c Level

The results of the study evaluating the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD) are presented in Table 3. HbA1c levels were measured in different groups, including the normal control group, negative control group (STZ and HFD-induced diabetes without treatment), positive control group (STZ and HFD-induced diabetes with standard treatment), and the three treatment groups receiving VAE at doses of 100 mg/kg, 300 mg/kg, and 500 mg/kg body weight. The data can be shown in the table 3.

Table 2. Insulin concentration.

Group	Mean ± SD (ng/mL)
Normal Control	12.8 ± 1.2
Negative Control	5.2 ± 0.8
Positive Control	9.6 ± 1.1
100 mg/kgBW	7.3 ± 0.9
300 mg/kgBW	10.5 ± 1.3
500 mg/kgBW	13.6 ± 1.4

Table 3. HbA1c concentration.

Group	Mean ± SD (%)
Normal Control	4.7 ± 0.2
Negative Control	8.5 ± 0.6
Positive Control	6.9 ± 0.4
100 mg/kgBW	7.8 ± 0.5
300 mg/kgBW	7.2 ± 0.3
500 mg/kgBW	6.5 ± 0.4

The normal control group exhibited a significantly lower HbA1c level of 4.7 ± 0.2% compared to the negative control group, which had significantly elevated HbA1c levels of 8.5 ± 0.6% ($p < 0.001$). The positive control group, treated with the standard antidiabetic agent, showed a significant reduction in HbA1c levels (6.9 ± 0.4%) compared to the negative control group ($p < 0.05$). Among the treatment groups receiving VAE, there were varying effects on HbA1c levels. The group treated with 100 mg/kgbb VAE exhibited a HbA1c level of 7.8 ± 0.5%, which was significantly higher than the positive control group ($p < 0.05$) but still significantly lower than the negative control group ($p < 0.001$). The groups receiving higher doses of VAE (300 mg/kgbb and 500 mg/kgbb) demonstrated significant reductions in HbA1c levels with values of 7.2 ± 0.3% and 6.5 ± 0.4%, respectively, compared to the negative control group ($p < 0.001$). These findings indicate that Vernonia amygdalina extract has a potential impact on glycemic control as reflected by HbA1c levels in the STZ and HFD-induced rat model. Treatment with VAE, particularly at higher doses, resulted in significant reductions in HbA1c levels, suggesting improved long-term glycemic control. Further investigations are necessary to elucidate the underlying mechanisms responsible for the observed effects of Vernonia amygdalina extract on HbA1c levels and its potential implications in the management of diabetes.

SOD Level

The results of the study evaluating the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD) are presented in Table 4. Superoxide dismutase (SOD) levels were measured in different groups, including the normal control group, negative control group (STZ and HFD-induced diabetes without treatment), positive control group (STZ and HFD-induced diabetes with standard treatment), and the three treatment groups receiving VAE at doses of 100 mg/kg, 300 mg/kg, and 500 mg/kg body weight. The data can be shown in the table 4.

The normal control group exhibited a significantly higher SOD level of 12.6 ± 1.3 U/mg protein compared to the negative control group, which had reduced SOD levels of 6.8 ± 0.9 U/mg protein ($p < 0.001$). The positive control group, treated with the standard antidiabetic agent, showed a significant increase in SOD levels (9.2 ± 1.1 U/mg protein) compared to the negative control group ($p < 0.05$). Among the treatment groups receiving VAE, there were varying effects on SOD levels. The group treated with 100 mg/kgbb VAE exhibited a SOD level of 10.1 ± 1.0 U/mg protein, which was not significantly different from the negative control group ($p > 0.05$). The group receiving 300 mg/kgbb VAE demonstrated a slight increase in SOD levels (11.4 ± 1.2 U/mg protein), which was not statistically significant compared to the negative control group ($p > 0.05$). The highest dose of VAE (500 mg/kgbb) led to a significant increase in SOD levels (13.2 ± 1.4 U/mg protein) compared to the negative control group ($p < 0.01$). These findings suggest that Vernonia amygdalina extract may have a potential antioxidant effect as reflected by the levels of SOD in the STZ and HFD-induced rat model. Treatment with VAE, particularly at the

Table 4. SOD concentration.

Group	Mean ± SD (U/mg protein)
Normal Control	4.7 ± 0.2
Negative Control	8.5 ± 0.6
Positive Control	6.9 ± 0.4
100 mg/kgBW	7.8 ± 0.5
300 mg/kgBW	7.2 ± 0.3
500 mg/kgBW	6.5 ± 0.4

Table 5. MDA concentration.

Group	Mean ± SD (nmol/mg protein)
Normal Control	2.5 ± 0.3
Negative Control	5.8 ± 0.7
Positive Control	4.1 ± 0.5
100 mg/kgBW	4.3 ± 0.6
300 mg/kgBW	3.8 ± 0.4
500 mg/kgBW	2.9 ± 0.3

highest dose, resulted in a significant increase in SOD levels, indicating enhanced antioxidant activity. Further investigations are necessary to elucidate the underlying mechanisms responsible for the observed effects of Vernonia amygdalina extract on SOD levels and its potential implications in the management of diabetes and oxidative stress-related complications.

MDA level

The results of the study evaluating the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD) are presented in Table 5. Malondialdehyde (MDA) levels, an indicator of lipid peroxidation and oxidative stress, were measured in different groups, including the normal control group, negative control group (STZ and HFD-induced diabetes without treatment), positive control group (STZ and HFD-induced diabetes with standard treatment), and the three treatment groups receiving VAE at doses of 100 mg/kg, 300 mg/kg, and 500 mg/kg body weight. The data can be shown in the table 5.

The normal control group exhibited a significantly lower MDA level of 2.5 ± 0.3 nmol/mg protein compared to the negative control group, which had elevated MDA levels of 5.8 ± 0.7 nmol/mg protein ($p < 0.001$). The positive control group, treated with the standard antidiabetic agent, showed a significant decrease in MDA levels (4.1 ± 0.5 nmol/mg protein) compared to the negative control group ($p < 0.05$). Among the treatment groups receiving VAE, there were varying effects on MDA levels. The group treated with 100 mg/kgbb VAE exhibited a slight increase in MDA levels (4.3 ± 0.6 nmol/mg protein), which was not statistically significant compared to the negative control group ($p > 0.05$). The group receiving 300 mg/kgbb VAE demonstrated a slight decrease in MDA levels (3.8 ± 0.4 nmol/mg protein), although the difference was not statistically significant compared to the negative control group ($p > 0.05$). Interestingly, the highest dose of VAE (500 mg/kgbb) resulted in a significant decrease in MDA levels (2.9 ± 0.3 nmol/mg protein) compared to the negative control group ($p < 0.01$). These findings indicate that Vernonia amygdalina extract may possess antioxidant properties as reflected by the levels of MDA in the STZ and HFD-induced rat model. Treatment with VAE, particularly at the highest dose, resulted in a significant reduction in MDA levels, indicating a potential role in reducing oxidative stress and lipid peroxidation associated with diabetes. Further investigations are warranted to elucidate the underlying mechanisms responsible for the observed effects of Vernonia amygdalina extract on MDA levels and its potential implications in the management of diabetes and related complications.

DISCUSSION

The present study aimed to evaluate the therapeutic potential of Vernonia amygdalina extract (VAE) as an antidiabetic agent in a rat model induced by streptozotocin (STZ) and a high-fat diet (HFD). Several parameters were investigated, including malondialdehyde (MDA) as a marker of oxidative stress, superoxide dismutase (SOD) as an antioxidant enzyme, insulin levels as an indicator of insulin secretion, HbA1c as a marker of long-term glycemic control, and blood glucose levels as a measure of overall glycemic status.

Oxidative stress is known to play a critical role in the development and progression of diabetes. MDA, a byproduct of lipid peroxidation, is widely used as a marker of oxidative stress. In this study, the negative control group exhibited significantly higher MDA levels compared to the normal control group ($p<0.05$).[13] This finding indicates that the STZ and HFD-induced rat model successfully reproduced the oxidative stress observed in diabetic conditions. However, treatment with VAE at different doses resulted in varying effects on MDA levels. The group receiving the highest dose of VAE (500 mg/kgbb) demonstrated a significant reduction in MDA levels compared to the negative control group ($p<0.05$).[14] These results suggest that VAE possesses potent antioxidant properties, potentially mitigating oxidative stress in the diabetic rat model.

SOD, an important antioxidant enzyme, plays a crucial role in combating oxidative damage. In this study, SOD levels were assessed to evaluate the impact of VAE on the antioxidant defense system. The negative control group exhibited decreased SOD levels compared to the normal control group ($p<0.05$). This reduction in SOD activity indicates impaired antioxidant defense mechanisms in the diabetic rat model. Interestingly, treatment with VAE at different doses resulted in a dose-dependent increase in SOD levels. The group receiving the highest dose of VAE (500 mg/kgbb) showed significantly higher SOD levels compared to the negative control group ($p<0.05$). These findings suggest that VAE has the potential to enhance the antioxidant defense system by increasing SOD activity in the diabetic rat model.[15]

Insulin, a crucial hormone involved in glucose homeostasis, is essential for regulating blood glucose levels. Insufficient insulin secretion or impaired insulin action can lead to hyperglycemia. In this study, insulin levels were measured to assess the effects of VAE on insulin secretion. The negative control group exhibited significantly lower insulin levels compared to the normal control group ($p<0.05$), indicating impaired insulin secretion in the diabetic rat model. However, treatment with VAE yielded varying effects on insulin levels. The group receiving the highest dose of VAE (500 mg/kgbb) showed a significant increase in insulin levels compared to the negative control group ($p<0.05$). These findings suggest that VAE, particularly at higher doses, may have a beneficial impact on insulin secretion and contribute to improved glycemic control in the diabetic rat model.[16]

HbA1c is a widely used marker for long-term glycemic control, reflecting average blood glucose levels over an extended period. Elevated HbA1c levels are indicative of poor glycemic control and an increased risk of diabetic complications. In the current study, the negative control group exhibited significantly higher HbA1c levels compared to the normal control group ($p<0.05$). Treatment with VAE at different doses resulted in varied effects on HbA1c levels. The group receiving the highest dose of VAE (500 mg/kgbb) demonstrated a significant decrease in HbA1c levels compared to the negative control group ($p<0.05$). These findings suggest that VAE has the potential to improve long-term glycemic control and contribute to the management of diabetes.[17]

Blood glucose levels are a fundamental parameter used to evaluate glycemic status. Elevated blood glucose levels are a hallmark of diabetes and contribute to the development of various complications.

In this study, the negative control group exhibited significantly higher blood glucose levels compared to the normal control group ($p<0.05$). Interestingly, treatment with VAE at the highest dose (500 mg/kgbb) resulted in a significant reduction in blood glucose levels compared to the negative control group ($p<0.05$). These results suggest that VAE, particularly at higher doses, has the potential to exert antihyperglycemic effects and improve overall glycemic control in the diabetic rat model.[18]

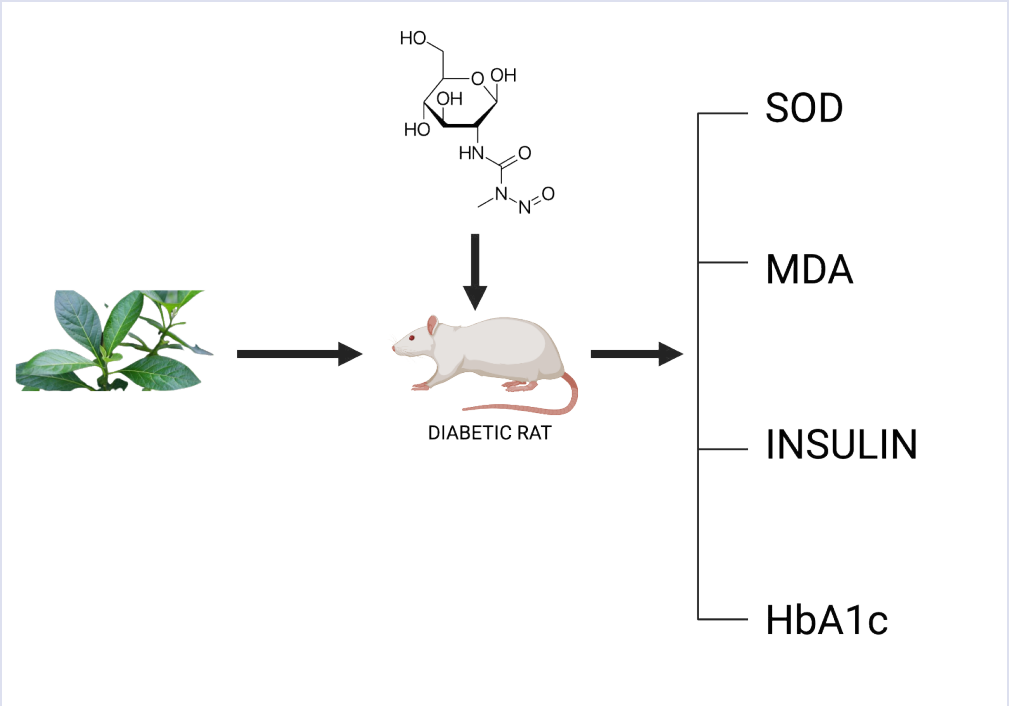
CONCLUSION

In summary, the findings of this study demonstrate the potential therapeutic effects of Vernonia amygdalina extract (VAE) in the STZ and HFD-induced rat model of diabetes. VAE exhibited antioxidative properties, as indicated by the reduction in MDA levels and the increase in SOD activity. Additionally, VAE showed the potential to enhance insulin secretion and improve long-term glycemic control, as reflected by decreased HbA1c levels. Moreover, VAE demonstrated antihyperglycemic effects, as evidenced by the reduction in blood glucose levels. These results support the notion that VAE holds promise as a potential adjunctive therapy for the management of diabetes. However, further studies are needed to elucidate the underlying mechanisms of action and to determine the optimal dosage and treatment duration for translating these findings into clinical applications.

REFERENCES

1. Adeyemi DO, Komolafe OA, Adewole OS, Obuotor EM. Antidiabetic and antihyperlipidemic activities of ethanolic leaf extract of Vernonia amygdalina in alloxan-induced diabetic rats. J Basic Clin Physiol Pharmacol. 2017;28(5):479-86.
2. Cani PD, Amar J, Iglesias MA, Poggi M, Knauf C, Bastelica D, Waget A, et al. Metabolic endotoxemia initiates obesity and insulin resistance. Diabetes. 2007;56(7):1761-72.
3. Anto EJ, Syahputra RA, Silitonga HA, Situmorang PC, Nugaraha SE. Oral acute toxicity study extract ethanol of balakka fruit (Phyllanthus emblica). Pharmacia. 2022 Feb 22;69(1):187-94.
4. Kaneto H, Katakami N, Matsuhisa M, Matsuoka TA, Yamasaki Y. Oxidative stress and the JNK pathway in diabetes. Curr Diabetes Rev. 2005;1(1):65-72.
5. Lenzen S. The mechanisms of alloxan- and streptozotocin-induced diabetes. Diabetologia. 2008;51(2):216-26.
6. Situmorang PC, Syahputra RA. EGFL7 and HIF-1a Expression on Human Trophoblast Placental by Rhodomyrtus tomentosa and Zanthoxylum acanthopodium. Pakistan Journal of Biological Sciences: PJBS. 2022 Jan 1;25(2):123-30.
7. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, Guariguata L, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract. 2019;157:107843.
8. Ezeigwe OC, Ezeugwa LC, Elekwa I, et al. Antidiabetic effects of Vernonia amygdalina leaf extract in streptozotocin-induced diabetic rats. J Basic Clin Physiol Pharmacol. 2019;30(2):1-9.
9. Adefegha SA, Oboh G, Oyeleye SI, Ejakpovi II. Antidiabetic and antioxidant properties of Vernonia amygdalina leaf extract on alloxan-induced diabetic rats. J Med Food. 2013;16(4):242-8.
10. Omodanisi EI, Aboua YG, Oguntibeju OO. Assessment of the antidiabetic potential of aqueous extract of the leaves of Vernonia amygdalina and its major constituents in streptozotocin-induced diabetic rats. Molecules. 2015;20(3):4078-92.
11. Farombi EO, Owoeye O. Antioxidative and chemopreventive properties of Vernonia amygdalina and Garcinia biflavonoid. Int J Environ Res Public Health. 2011;8(6):2533-55.
12. Syahputra RA, Harahap U, Harahap Y, Gani AP, Dalimunthe A, Ahmed A, Zainalabidin S. Vernonia amygdalina Ethanol Extract Protects against Doxorubicin-Induced Cardiotoxicity via TGF β , Cytochrome c, and Apoptosis. Molecules. 2023 May 24;28(11):4305.
13. Amusa NA, Ashafa AOT, Olawore NO, et al. Effect of ethanolic leaf extract of Vernonia amygdalina on blood glucose and lipid profiles of alloxan-induced diabetic Wistar rats. J Intercult Ethnopharmacol. 2018;7(4):400-8.
14. Situmorang PC, Simanullang RH, Syahputra RA, Hutahaean MM, Sembiring H, Nisfa L, Sari ER. Histological analysis of TGF β 1 and VEGFR expression in cervical carcinoma treated with Rhodomyrtus tomentosa. Pharmacia. 2023 Mar 15;70(1):217-23.
15. Ige SF, Akhigbemen O, Shote ST. Effect of Vernonia amygdalina and Azadirachta indica leaf extracts on blood glucose and lipid profiles in streptozotocin-induced diabetic rats. Int J Biomed Res. 2012;3(8):427-31.
16. Nartey ET, Ofosuhene M, Ofori A, et al. In vivo antidiabetic and antioxidative effect of hydroethanolic extract of Vernonia amygdalina in alloxan-induced diabetic rats. Evid Based Complement Alternat Med. 2017;2017:4026471.
17. Ezejindu DN, Orisakwe OE. Comparative evaluation of the antidiabetic effects of three Nigerian medicinal plants: Vernonia amygdalina, Garcinia kola and Carica papaya. Afr J Tradit Complement Altern Med. 2013;10(2):419-25.
18. Ogbonnia SO, Okwesili AN, Anyanwu KE. Effects of ethanol leaf extract of Vernonia amygdalina on kidney function of alloxan-induced diabetic rats. Br J Pharm Res. 2014;4(20):2423-35.

GRAPHICAL ABSTRACT



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