

Effectiveness of Calotropis leaf on HbA1c level among Type 2 Diabetes Mellitus clients

Santhi Sujatha Mary T^{1,*} and Dr Blessy Peter²

¹ Ph.D Scholar, Mansarovar Global University, Sehore, Bhopal, Madhya Pradesh, India.

² Professor and Research Guide, Faculty of Nursing Science, Mansarovar Global University, Sehore, Bhopal, Madhya Pradesh, India.

World Journal of Biology Pharmacy and Health Sciences, 2025, 24(02), 274-282

Publication history: Received on 29 September 2025; revised on 05 November 2025; accepted on 07 November 2025

Article DOI: <https://doi.org/10.30574/wjbphs.2025.24.2.0995>

Abstract

Introduction: Type 2 Diabetes Mellitus, a prevalent chronic metabolic disorder, continues to pose a significant global health challenge with rising incidence and associated complications. Despite advancements in conventional treatments, Type 2 Diabetes Mellitus clients struggle to achieve optimal glycemic control, as indicated by HbA1c levels. This necessitates an exploration of complementary approaches, which offer promising avenues. Calotropis procera and Calotropis gigantea have a history in traditional medicine for treating various ailments, including reported hypoglycemic effects, which warrant scientific investigation into their topical application.

Aim: This study aimed to evaluate the effectiveness of Calotropis leaf application on HbA1c levels among Type 2 Diabetes Mellitus clients in a selected community in Coimbatore.

Materials and Methods: A quasi-experimental pretest-posttest design was employed with 100 clients with Type II Diabetes Mellitus (50 experimental, 50 control), selected by convenience sampling. The experimental group received routine treatment, supplemented with daily application of Calotropis leaves under the soles, for 60 days, while the control group received only routine treatment. HbA1c levels were measured at baseline (Day 1) and after 60 days (Day 60) for both groups. Data were analyzed using descriptive and inferential statistics, including t-tests and chi-square tests.

Results: At baseline, both groups had comparable mean HbA1c levels (Experimental: 9.70 ± 0.78 ; Control: 9.73 ± 1.15 ; $P=0.887$). After 60 days, the experimental group showed a significant reduction in mean HbA1c to 6.66 ± 1.63 (paired $t = 13.94$, $P = 0.000$), with 42.0% achieving normal levels and 32.0% achieving pre-diabetes levels. Whereas, the control group's mean HbA1c remained unchanged (9.72 ± 1.27 ; paired $t=0.081$, $P=0.935$). A highly significant difference in post-intervention mean HbA1c was observed between groups (mean difference=3.06, unpaired $t=10.475$, $P=0.000$).

Conclusion: The application of Calotropis leaves proved to be a highly effective complementary intervention, significantly reducing HbA1c levels in type 2 diabetes mellitus clients. This suggests its potential as a valuable and accessible to conventional diabetes management.

Keywords: Diabetes Mellitus; Calotropis Leaf; Hba1c; Type 2 Diabetes Mellitus

1. Introduction

Diabetes Mellitus, a chronic metabolic disorder characterized by elevated blood glucose levels resulting from defects in insulin secretion, insulin action, or both, poses a significant global health challenge. According to the International Diabetes Federation (IDF), the prevalence of diabetes continues to rise, impacting millions worldwide and leading to

* Corresponding author: Santhi Sujatha Mary T

complications such as cardiovascular disease, nephropathy, retinopathy, and neuropathy [4]. Among the various forms, Type 2 Diabetes Mellitus accounts for the vast majority of cases, often linked to lifestyle factors including obesity, physical inactivity, and unhealthy dietary patterns. The long-term management of Type 2 Diabetes Mellitus primarily focuses on glycemic control, with Glycated Hemoglobin (HbA1c) serving as a crucial indicator of average blood glucose levels over the preceding two to three months. Maintaining optimal HbA1c levels is crucial in preventing the onset and progression of diabetes-related complications, thereby enhancing the quality of life for individuals affected by the condition. It is projected that the population of diabetics in India will rise significantly from 77 million in 2019 to 134.2 million in 2045 [4].

Despite advancements in conventional medical treatments for Type II Diabetes Mellitus, including oral hypoglycemic agents and insulin therapy, a substantial portion of the diabetic population continues to struggle with achieving and maintaining desired glycemic targets. Factors such as medication adherence issues, side effects, and the progressive nature of the disease often necessitate a multifaceted approach to management. This has led to a growing interest in complementary and alternative medicine approaches, particularly those derived from traditional herbal remedies, which have been utilized for centuries in various cultures for their therapeutic properties. Many plant-based interventions are explored for their potential to modulate blood glucose levels, compared to conventional pharmaceuticals.

India, with its rich biodiversity and ancient systems of medicine such as Ayurveda and Siddha, has a long history of utilizing medicinal plants to treat various ailments, including diabetes. The exploration of traditional remedies is crucial, not only for validating their efficacy and safety but also for potentially discovering novel compounds that could contribute to the development of new antidiabetic drugs. One such plant, *Calotropis procera* or *Calotropis gigantea*, commonly known as the "Aak plant" in India, has a documented history of use in traditional medicine for various conditions, including those associated with metabolic disorders [9, 11]. Multiple parts of the *Calotropis* plant, including its leaves, latex, roots, and flowers, have been traditionally employed for their anti-inflammatory, analgesic, and antipyretic properties. Of particular interest in the context of diabetes management are its reported hypoglycemic effects. Anecdotal evidence from in vitro and in vivo studies, as well as traditional practices, suggests that the application of *Calotropis* leaf contributes to blood glucose regulation, prompting further scientific inquiry into its potential mechanisms of action [1, 2, 3, 6, 7, 8, 10].

Several research studies have investigated the pharmacological properties of *Calotropis* species, with a specific focus on their potential as antidiabetic agents. For instance, studies on "*Calotropis* antidiabetic properties" or "*Calotropis* hypoglycemic effect" have indicated the presence of various bioactive compounds, such as cardiac glycosides, flavonoids, triterpenoids, and steroids, which may contribute to its observed effects [9]. Studies on animal models, such as those conducted by the *Calotropis* diabetes animal study, have demonstrated a reduction in blood glucose levels and improvement in insulin sensitivity following the administration of *Calotropis* extracts [2, 3, 6, 8, 10]. These preliminary findings provide a scientific basis for investigating its application in human subjects. Furthermore, studies on *Calotropis*' traditional use for diabetes and ethnobotanical surveys of *Calotropis* have consistently reported the traditional use of *Calotropis* in managing diabetes in various regions [5, 11]. The study on the *Calotropis* diabetes clinical trial, which focuses on in-vitro or animal studies, highlighted its application in traditional healing systems for blood sugar control. While these studies provide valuable insights into its potential, a significant gap remains in clinical evidence, particularly concerning the direct topical application of *Calotropis* leaf and its impact on long-term glycemic markers, such as HbA1c, in human subjects with Type 2 Diabetes Mellitus.

The current conventional management of Type 2 Diabetes Mellitus often involves oral medications or insulin injections, which can have associated side effects or require strict adherence. Given the traditional claims and preliminary scientific evidence supporting the antidiabetic properties of *Calotropis*, a focused investigation into its effectiveness on HbA1c levels is necessary. This study aims to bridge the existing knowledge gap by specifically assessing the impact of topical *Calotropis* leaf application on HbA1c levels among Type 2 Diabetes Mellitus clients within a selected community in Coimbatore.

Projected outcome: This study is designed to systematically evaluate the effectiveness of the application of *Calotropis* leaf in normalizing HbA1c levels in Type 2 Diabetes Mellitus clients. The findings from this research will contribute valuable evidence to the existing body of knowledge regarding traditional herbal remedies for diabetes management. They may offer a cost-effective and accessible complementary therapy for individuals struggling with glycemic control. Also, the results of this study could inform healthcare practices and potentially lead to the integration of evidence-based traditional remedies into a holistic approach to diabetes care in community settings.

1.1. Statement of Problem

A study to assess the effectiveness of the application of Calotropis leaf on HbA1c level among Type 2 Diabetes Mellitus clients in a selected community at Coimbatore.

Objectives

- To assess the HbA1c level among Type 2 Diabetes Mellitus clients before application of Calotropis leaf.
- To assess the HbA1c level among Type 2 Diabetes Mellitus clients after application of Calotropis leaf.
- To evaluate the effectiveness of the application of Calotropis leaf on HbA1c level among Type 2 Diabetes Mellitus clients in the experimental group before and after application of Calotropis leaf.
- To find out the association between HbA1c level and selected demographic variables among Type 2 Diabetes Mellitus clients in the baseline data.

2. Operational Definition

HbA1c level: It is defined as the percentage of hemoglobin that is bound to glucose in the red blood cells, reflecting the average blood glucose level over the preceding 2 months. It will be measured using a standardized laboratory method from a blood sample collected by a nurse researcher. The results will be expressed as a percentage.

Calotropis leaf: It is a medicinal plant leaf, which is a thick, greyish-green leaf found on the Calotropis plant. It's usually large, leathery, and often covered with a whitish fuzz. It grows directly on the stem, which has the property of a diabetogenic chemical agent used in the treatment of pancreatic beta cells. In this study, fresh Calotropis leaves are taken and washed. The rough part of the Calotropis leaves is kept under the sole daily from morning to evening, and the Calotropis leaf application is continued for 60 days.

2.1. Hypothesis

- H1: There will be a significant difference in the mean HbA1c Score before and after application of Calotropis leaf
- H2: There will be a significant difference in the mean HbA1c Score between the experimental group and the control group after application of Calotropis leaf.

2.2. Assumption

- Diabetes is a long-term, manageable disease
- Changes in health habits can help to manage diabetes
- Controlling blood sugar prevents serious health issues
- Calotropis leaves can influence blood sugar levels

2.3. Delimitation

- The study was conducted in a selected community within Coimbatore
- The study includes clients diagnosed with type II diabetes mellitus under routine treatment (anti-diabetic drug)

3. Research Methodology

The research was conducted in Kangayampalayam village, a rural community in Coimbatore. This was a single-center, quantitative evaluative study employing a quasi-experimental pretest-posttest design. A total of 100 clients with Type 2 Diabetes Mellitus were included as samples in the study. These participants were recruited from a screening camp held in the Kangayampalayam community area and were selected using a convenience sampling technique. The samples were divided into two groups, 50 in the experimental group and 50 in the control group. The control group received routine treatment, while the experimental group received routine treatment in addition to the application of Calotropis leaves.

The participants included medically fit individuals between the ages of 30 and 60 years. Clients with chronic diseases such as liver disease, arthritis, pulmonary tuberculosis, asthma, renal failure, a history of coronary heart disease, acute myocardial infarction, valvular heart diseases, cerebrovascular disease, malabsorption, alcoholism, and pregnant women with diabetes were excluded. Smokers and non-cooperative patients were also excluded from the study.

The research tool consisted of a questionnaire that captured demographic data and clinical parameters, along with lab test reports for HbA1c values. Demographic data included age in years, gender, education level, occupation, marital status, monthly family income, duration since diabetes diagnosis, and family history of diabetes. Clinical parameters encompassed Body Mass Index (BMI) and blood sugar levels, as obtained from lab reports. Glycosylated hemoglobin (HbA1c) levels were measured for all clients at baseline and after 2 months.

3.1. Scoring Procedure

Clients were classified into three categories based on their blood glucose scores. These scores were obtained from lab reports and classified according to predefined ranges.

HbA1c Level	Score
Normal	< 5.7%
Pre Diabetes	5.7% - 6.4%
Diabetes	> 6.5%

4. Data Collection Procedure

Before the study, formal permission was obtained from the Panchayat President. A screening camp was conducted in the selected community with the assistance of the Primary Health Centre (PHC) to identify clients with Type II Diabetes Mellitus. Informed consent was secured from all clients who agreed to participate in the study. The researcher introduced herself to each participant, explaining the purpose of the study. Initial measurements of height and weight were taken, and personal and socioeconomic information were collected. Subsequently, blood samples were collected by the investigator and sent to the laboratory for blood glucose testing to determine baseline HbA1c scores. For the experimental group, the researcher provided a detailed demonstration of the Calotropis leaf application. Calotropis leaves were collected directly from the community area. Fresh Calotropis leaves were thoroughly washed. The rough part of the Calotropis leaves was carefully placed under the sole of each foot, ensuring direct contact with the sole. Socks were then worn over the leaves and retained for the entire day. The leaves were removed before bedtime, and the feet were washed. This Calotropis leaf application continued for a period of 60 days. The researcher conducted daily visits to the participants in the experimental group to ensure consistent adherence to the Calotropis leaf application, verifying that the leaves were correctly placed under the soles and that socks were worn. After the 60-day intervention period, a second blood glucose test was conducted in the laboratory to assess the post-intervention HbA1c values. The researcher took the expenses associated with all laboratory tests. The clients continued their anti-diabetic medications as prescribed and maintained consistency for both groups throughout the study period. The overall research duration was four months. During the first two months, the control group was observed, and their baseline blood glucose scores were recorded. The intervention for the experimental group commenced after the completion of these initial two months. Upon the conclusion of the study period, the researcher explained the procedure for applying the Calotropis leaves to the control group, ensuring they also received the information regarding the potential intervention.

4.1. Statistical analysis

Data analysis was conducted using SPSS software, based on the study's objectives and hypotheses, employing both descriptive and inferential statistics. The descriptive statistics include the frequency and percentage distribution of data, as well as the mean and standard deviation. Inferential statistics include the t-test for comparing groups and the chi-square test for assessing the association between demographic variables and HbA1c levels, with a significance level set at $P < 0.05$. It is considered non-significant if $P > 0.05$.

4.2. Ethical Consideration

Ethical approval was obtained from the Institutional Ethical Committee. Written permission was obtained from the relevant authorities of the community, ensuring informed consent from all participants after a clear explanation of the study was provided. Anonymity and privacy were maintained throughout the study.

5. Result

Table 1 Frequency and percentage distribution according to demographic characteristics

Demographic Characteristics		Experimental Group (N1=50) F (%)	Control Group (N2=50) F (%)
Age in Years	30-40 Years	11 (22.0)	16 (32.0)
	40-50 Years	26 (52.0)	22 (44.0)
	50-60 Years	13 (26.0)	12 (24.0)
Gender	Male	32 (64.0)	27 (54.0)
	Female	18 (36.0)	23 (46.0)
Educational Status	Illiterate	3 (6.0)	7 (14.0)
	Primary level	12 (24.0)	9 (18.0)
	Secondary level	16 (32.0)	21 (42.0)
	High School	9 (18.0)	7 (14.0)
	Higher Secondary School	8 (16.0)	5 (10.0)
	Graduate and above	2 (4.0)	1 (2.0)
Occupation	Unemployed	7 (14.0)	4 (8.0)
	Retired	2 (4.0)	6 (12.0)
	Govt employee	8 (16.0)	5 (10.0)
	Private employee	12 (24.0)	9 (18.0)
	Self employed	21 (42.0)	26 (52.0)
Marital status	Married	37 (74.0)	33 (66.0)
	Unmarried	4 (8.0)	6 (12.0)
	Divorced/Separated	1 (2.0)	2 (4.0)
	Widow	8 (16.0)	9 (18.0)
BMI	Normal	17 (34.0)	19 (38.0)
	Overweight	25 (50.0)	18 (36.0)
	Obese	8 (16.0)	13 (26.0)
Family Income per month	< Rs 10,000/-	8 (16.0)	11 (22.0)
	Rs 10,001-15,000/-	13 (26.0)	9 (18.0)
	Rs 15,001-20,000/-	23 (46.0)	27 (54.0)
	> Rs 20,000/-	6 (12.0)	3 (6.0)
Duration diagnoses of diabetes	< 6 months	7 (14.0)	9 (18.0)
	6 month- 1 Year	17 (34.0)	23 (46.0)
	1-2 years	12 (24.0)	11 (22.0)
	> 2 years	14 (28.0)	7 (14.0)
Family history of diabetes	Yes	17 (34.0)	22 (44.0)
	No	33 (66.0)	28 (56.0)

The findings from the demographic characteristics reveal that, in terms of age, the experimental group had 26 (52.0%) clients aged 40-50 years. In comparison, the control group had 22 (44.0%) in the same range, suggesting a slightly higher number of clients in the experimental group. Conversely, 16 (32.0%) clients in the control group were aged 30-40 years, compared to 11 (22.0%) in the experimental group. The gender distribution showed a higher proportion of

males in the experimental group, with 32 (64.0%) males versus 18 (36.0%) females. In contrast, the control group was more balanced, comprising 27 (54.0%) males and 23 (46.0%) females. For educational status, the largest category in the experimental group was secondary level, with 16 (32.0%) clients, whereas the control group had an even higher concentration at this level, with 21 (42.0%). Regarding occupation, self-employed individuals constituted the largest group in both, with 21 (42.0%) in the experimental group and 26 (52.0%) in the control group. The majority of participants in both groups were married, accounting for 37 (74.0%) in the experimental group and 33 (66.0%) in the control group. In terms of BMI, the experimental group had a higher percentage of overweight individuals (25, 50.0%) compared to the control group (18, 36.0%). In comparison, the control group showed a greater proportion of obese individuals with 13 (26.0%), than the experimental group, 8 (16.0%). For family income per month, the most frequent category for both groups was Rs 15,001-20,000/-, with 23 (46.0%) in the experimental group and 27 (54.0%) in the control group. Regarding the duration since diabetes diagnosis, the control group had a higher frequency of participants diagnosed between 6 months and 1 year, 23 (46.0%), than the experimental group, 17 (34.0%). The family history of diabetes was slightly more prevalent in the control group, with 22 (44.0%) reporting a family history, compared to 17 (34.0%) in the experimental group.

Table 2 Frequency and percentage distribution of levels of HbA1c in the experimental and control groups before and after application of Calotropis leaf

HbA1c Level	Experimental Group (N=50)				Control Group (N=50)			
	Before Intervention		After Intervention		Baseline Observation		Subsequent Observation	
	Day 1		Day 60		Day 1		Day 60	
	F	%	F	%	F	%	F	%
Normal (< 5.7%)	-	-	21	42.0	-	-	-	-
Pre Diabetes (5.7% - 6.4%)	-	-	16	32.0	-	-	-	-
Diabetes (> 6.5%)	50	100.0	13	26.0	50	100.0	50	100.0

Table 3 Comparison of the mean HbA1c score in experimental and control groups before and after application of Calotropis leaf

Group	Experimental Group (N=50)		Control Group (N=50)		Mean Difference	Unpaired t-value	DF	P Value
	Mean	SD	Mean	SD				
Before Intervention	9.70	0.78	9.73	1.15	0.03	0.143	98	0.887 NS
After Intervention	6.66	1.63	9.72	1.27	3.06	10.475	98	0.000 **

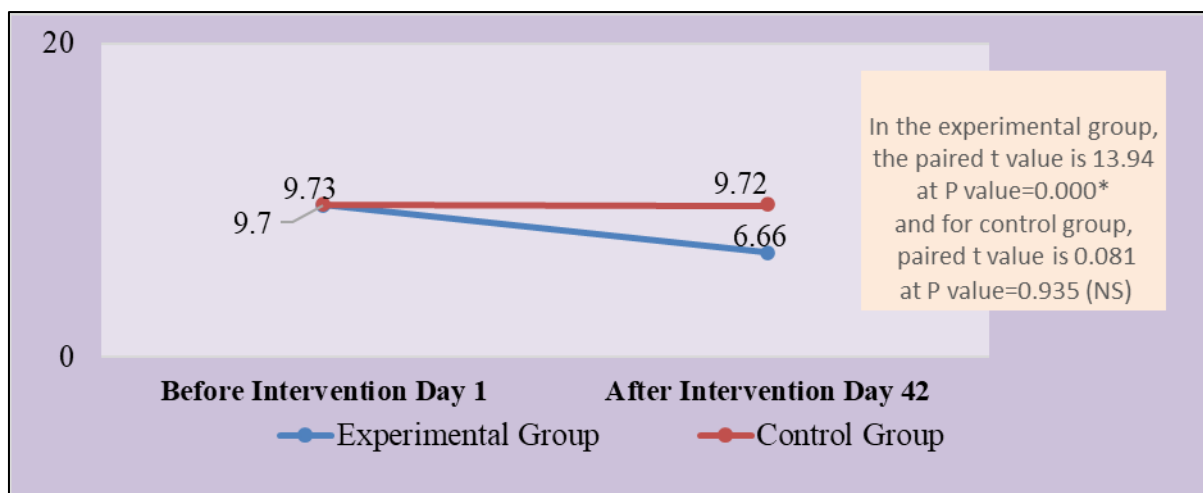


Figure 1 Mean HbA1c score before and after application of Calotropis leaf in the experimental and control groups

The study's findings revealed that at baseline, both the experimental and control groups had comparable mean HbA1c levels (9.70 and 9.73, respectively; $P = 0.887$), indicating no significant difference. However, following 60 days of intervention, the experimental group showed a statistically significant reduction in mean HbA1c to 6.66. This substantial improvement was further evidenced by a highly significant unpaired t-test result comparing the post-intervention means of the two groups (mean difference = 3.06, $t = 10.475$, $P = 0.000$). Furthermore, the paired t-test within the experimental group confirmed a highly significant reduction from baseline ($t = 13.94$, $P = 0.000$), while no significant change was observed within the control group ($t = 0.081$, $P = 0.935$). These statistical findings, supported by the marked shift of 42.0% of experimental group participants to normal HbA1c levels and 32.0% to pre-diabetes, strongly support the integration of Calotropis leaf application as an effective complementary therapy for improved glycemic control in Type 2 Diabetes Mellitus clients.

Also, the study reveals that there was no significant association observed between HbA1c level and selected demographic variables among Type 2 Diabetes Mellitus clients in the baseline data at $P < 0.05$.

6. Discussion

The current study, found a substantial reduction in HbA1c levels from 9.70% to 6.66% in human subjects, was strongly supported by the animal-based research of Ahmad & Gwerz (2016). While the animal study involved the oral administration of Calotropis extract and measured short-term fasting blood glucose, it established the plant's hypoglycemic and antioxidant properties by showing a significant drop in blood glucose from 15.5 mmol/L to 5.9 mmol/L in diabetic rats [6]. The present study's use of a topical application on humans and the assessment of long-term glycemic control via HbA1c over 60 days represents a crucial advancement. This demonstrates that the plant's active compounds are effectively absorbed through the skin, leading to a sustained systemic effect and validating its potential as a safe, non-invasive, and effective complementary therapy for Type II Diabetes Mellitus.

7. Conclusion

The study concluded that the application of Calotropis leaves is a highly effective, safe, accessible, and cost-effective complementary intervention for managing HbA1c levels in Type 2 Diabetes Mellitus clients within a community setting. The findings provide strong evidence that this traditional remedy can be a valuable addition to conventional diabetes management. Also, the finding could empower community health nurses and other healthcare providers to offer a holistic approach to diabetes care, particularly in resource-limited settings.

Limitation

- The study used a convenience sample, so the results might not be generalized.
- The study was done for 2 months only, so the findings aren't able to ensure the impact of long-term positive effects on HbA1c levels.

Nursing Implications

The study has significant implications across nursing practice, education, administration, and research. The study emphasizes the essential role of community health nurses in implementing this evidence into their clinical practice by counseling clients with Type 2 Diabetes Mellitus on the application of *Calotropis* leaves as a complementary therapy, providing detailed instructions on its safe and appropriate use. Nurse educators should incorporate this evidence of the application of *Calotropis* leaves into nursing curricula. This will enable future nurses to address patients' diverse needs and engage in culturally informed health practices, fostering a balanced understanding of traditional and modern approaches to diabetes management. Nurse administrators can develop policies and protocols to ensure the safe integration of the intervention within healthcare settings, providing adequate resources for patient education and supporting patient care. Nurse researchers are encouraged to disseminate their findings and conduct further studies to explore the long-term efficacy, duration of *Calotropis* application, potential mechanisms of action, and patient experiences, thereby strengthening the evidence.

Recommendations

The findings of the study propose the following recommendations

- Replicate the study with larger samples.
- A comparative study can be done with other conventional treatments
- The study can be done with a long duration to see the effect of alleviating the symptoms.

Compliance with ethical standards

Acknowledgments

The author wishes to express gratitude to the guide, all participants, colleagues, and authorities who contributed to the successful completion of this research.

Disclosure of conflict of interest

The authors declare that there are no financial conflicts of interest that could be perceived as influencing the reported research study.

References

- [1] Yadav CK, Kumar A, Kumar D. In-Vitro Anti-Diabetic Activity and Phytochemical Screening of Ethanolic extract of *Calotropis gigantea* (Linn). ResearchGate. 2023.
- [2] Kumar H, Singh S, Sharma P, Devi T. Plant *Calotropis gigantea*: Management of Diabetic Nephropathy in Experimentally Induced Diabetes in Rats. Research Journal of Pharmacy and Technology. 2022;15(3):1090-6.
- [3] Neto MA, Barbosa AP, de Souza AA, Rocha-Filho PA, Pereira MR, Vasconcelos IM, et al. Phytomodulatory proteins isolated from *Calotropis procera* latex promote glycemic control by improving hepatic mitochondrial function in HepG2 cells. Journal of Ethnopharmacology. 2021;278:114294.
- [4] International Diabetes Federation. IDF Diabetes Atlas, 10th ed. Brussels, Belgium: International Diabetes Federation; 2021.
- [5] Daimari M, Lahon K, Singh J. An ethnobotanical survey of antidiabetic medicinal plants used by the Bodo tribe of Kokrajhar district, Assam. ResearchGate. 2019.
- [6] Ahmad MB, Gwarzo MY. Antioxidative and anti-hyperglycaemic effect of *Calotropis procera* in alloxan-induced diabetic rats. Journal of Medicinal Plants Research. 2016;10(5):74-9.
- [7] Bhagavathy S, Mary J. Antioxidant and Antidiabetic Potentials of *Calotropis gigantea* in RIN-5F Pancreatic Cell Lines. International Journal of Pharmaceutical and Phytopharmacological Research. 2015;4(5).
- [8] Etuk EU, Mohammed BJ. Evaluation of antihyperglycaemic activity of *Calotropis procera* leaves extract on streptozotocin-induced diabetes in Wistar rats. Revista Brasileira de Farmacognosia. 2011;21:444-8.
- [9] Khan AJ, Dixit VK. *Calotropis procera*: A review on its phytochemistry and pharmacology. Pharmacognosy Reviews. 2011;5(10):240-4.

- [10] Sharma D, Surana R, Parihar MS. Hypoglycemic Effect of *Calotropis gigantea* Linn. Leaves and Flowers in Streptozotocin-Induced Diabetic Rats. *Pharmacognosy Research*. 2011;3(3):200-4.
- [11] Patel DK, Prasad SK, Kumar R, Hemalatha S. Ethnobotany of *Calotropis gigantea* and *C. procera*. *ResearchGate*. 2008.