RESEARCH PAPER

IN VIVO AND IN VITRO EVALUATION OF ANTIDIABETIC PROPERTIES OF SELENICEREUS UNDATUS LEAF EXTRACT USING EXPERIMENTAL ANIMAL MODELS

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ABSTRACT
Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia and associated complications. Natural products rich in bioactive phytochemicals are increasingly being investigated as alternative therapeutic agents for diabetes management.
To evaluate the antidiabetic activity of ethanolic leaf extract of Selenicereus undatus (SUELE) through phytochemical characterization, in vitro α-amylase and α-glucosidase inhibition assays, and in vivo assessment using streptozotocin–nicotinamide-induced diabetic rats.

KEYWORDS
Selenicereus undatus; Diabetes mellitus; α-amylase; α-glucosidase; Streptozotocin; Metformin, etc.
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INTRODUCTION

Diabetes mellitus (DM) is a major global health concern characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The prevalence of diabetes is increasing rapidly, particularly in developing countries such as India. Type 2 diabetes mellitus (T2DM) accounts for approximately 90–95% of all diabetes cases and is associated with insulin resistance, obesity, and sedentary lifestyles.

Although several synthetic antidiabetic drugs are available, long-term treatment is frequently associated with adverse effects, high costs, and reduced patient compliance. Consequently, medicinal plants have gained considerable attention as alternative therapeutic agents due to their affordability, safety, and multi-target pharmacological actions. More than 300 plant species have been reported to possess antidiabetic properties. Selenicereus undatus (dragon fruit), a member of the Cactaceae family, contains diverse phytochemicals including flavonoids, phenolics, saponins, betalains, and carotenoids that exhibit antioxidant and potential hypoglycemic activities. Previous studies have demonstrated antioxidant, antimicrobial, anti-inflammatory, and metabolic regulatory activities of dragon fruit extracts.

The present study was undertaken to investigate the antidiabetic potential of ethanolic leaf extract of Selenicereus undatus through in vitro enzyme inhibition assays and in vivo evaluation in streptozotocin–nicotinamide-induced diabetic rats.

MATERIALS AND METHODS

Plant Material Collection and Authentication

Leaves of Selenicereus undatus were collected from Pusesawali (Karad), Satara District, Maharashtra, India, during September 2024. Botanical authentication was performed at the Botanical Survey of India (Voucher No. BSI/WRC/Tech./2024/PSB-14).

Preparation of Ethanolic Extract

Fresh leaves were shade-dried, pulverized, and subjected to ethanolic extraction. The obtained extract was concentrated and stored under refrigerated conditions until further use.

Phytochemical Screening

Qualitative phytochemical tests were performed to identify major secondary metabolites including alkaloids, flavonoids, tannins, phenolics, glycosides, saponins, and terpenoids.

Spectroscopic Characterization

UV–Visible Spectroscopy

UV–Visible spectral analysis was conducted to identify chromophoric constituents present in the extract.

FTIR Analysis

FTIR spectroscopy was performed to determine characteristic functional groups associated with bioactive phytochemicals.

Experimental Animals

Healthy Wistar albino rats (150–250 g) of either sex were maintained under standard laboratory conditions with free access to food and water.

Induction of Type 2 Diabetes

Type 2 diabetes was induced by intraperitoneal administration of nicotinamide (110 mg/kg) followed by streptozotocin (45 mg/kg). Diabetes was confirmed after 72 h by fasting blood glucose levels exceeding 200 mg/dL.

Experimental Design

Animals were divided into five groups (n = 6):

Group I: Normal Control

Group II: Diabetic Control

Group III: Metformin (50 mg/kg)

Group IV: SUELE (100 mg/kg)

Group V: SUELE (200 mg/kg)

Treatments were administered orally for 21 days. Blood glucose and body weight were recorded on Days 0, 3, 7, 14, and 21. Histopathological examinations were conducted at study completion.

In Vitro α-Amylase Inhibition Assay

The α-amylase inhibitory activity of SUELE was evaluated using starch as substrate and acarbose as the reference standard. Percentage inhibition was calculated spectrophotometrically.

In Vitro α-Glucosidase Inhibition Assay

α-Glucosidase inhibition was determined using p-nitrophenyl-α-D-glucopyranoside as substrate. EGCG served as the standard inhibitor.

Statistical Analysis

Data were expressed as mean ± SEM. Statistical significance was determined using one-way ANOVA followed by appropriate post hoc tests. Values of $p < 0.05$ were considered statistically significant.

RESULTS AND DISCUSSION

Phytochemical Screening

Phytochemical analysis revealed the presence of flavonoids, phenolics, saponins, tannins, and other secondary metabolites known for antioxidant and hypoglycemic activities.

UV–Visible and FTIR Characterization

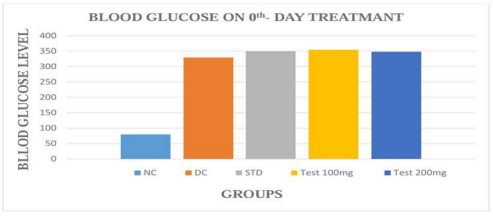
UV–Visible and FTIR analyses confirmed the presence of functional groups corresponding to phenolic and flavonoid compounds, supporting the phytochemical findings and potential antidiabetic activity.

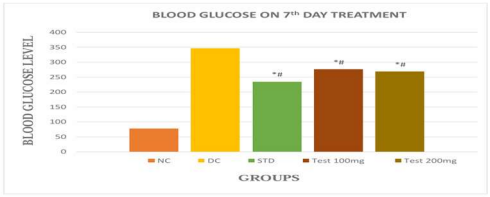
Effect on Blood Glucose Level

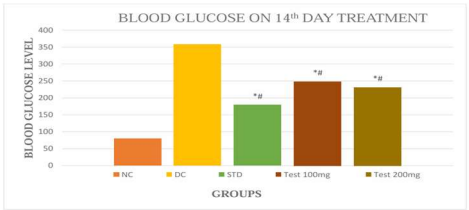
Administration of SUELE significantly reduced fasting blood glucose levels in diabetic rats. The reduction was dose-dependent, with the 200 mg/kg dose producing greater effects than the 100 mg/kg dose. At the end of the 21-day treatment period, the antidiabetic activity of SUELE approached that of metformin.

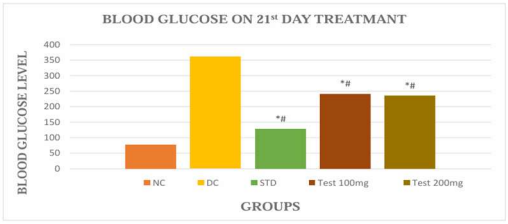
Effect of Selenicereus Undatus Leaves Ethanolic extracts on blood glucose level (mg/dl) in diabetic rats.

Sr.No.	GROUP	0-DAY	7-DAY	14-DAY	21-DAY
1.	NC	78.33 ± 2.692	77.17 ± 1.740	79.33 ± 1.333	77.67 ± 0.988
2.	DC	328.2 ± 4.175	345.7 ± 6.097	357.8 ± 9.372	360.2 ± 8.928
3.	STD	348.3±4.780*#	234.2 ± 21.60*#	179.0 ± 12.70*#	128.0 ± 12.43*#
4.	Test 100mg	352.5 ± 5.175*#	276.0 ± 6.216*#	248.0 ± 12.90*#	239.0 ± 8.653*#
5.	Test 200mg	347±4.1*#	268±5.4*#	231±9.42*#	242.1±12.50*#









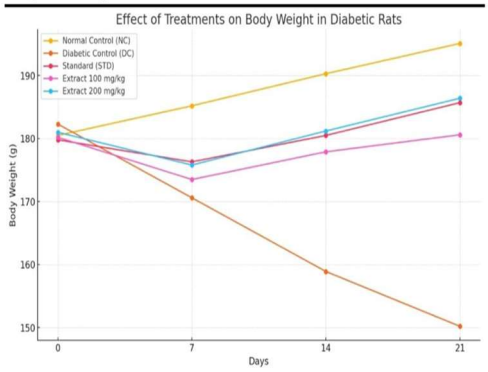
Effect on Body Weight

Diabetic animals exhibited weight loss, whereas treatment with SUELE improved body weight compared with diabetic controls, indicating amelioration of metabolic abnormalities.

Effect of Selenicereus Undatus Leaves Ethanolic extracts on body weight

S.N.	Group	Day 0 (g)	Day 7 (g)	Day 14 (g)	Day 21 (g)
1	Normal Control (NC)	180.5 ± 2.4	185.2 ± 2.6	190.3 ± 2.5	195.1 ± 2.7
2	Diabetic Control (DC)	182.3 ± 2.1	170.6 ± 3.0	158.9 ± 3.4	150.2 ± 2.9
3	Standard (STD)	179.8 ± 2.7	176.3 ± 2.9	180.5 ± 2.6	185.7 ± 2.4
4	Extract 100 mg/kg	181.0 ± 2.3	175.8 ± 2.6	181.2 ± 2.4	186.4 ± 2.5
5	Extract 200 mg/kg	180.2 ± 2.2	173.5 ± 2.8	177.9 ± 2.5	180.6 ± 2.3

Graph of Body Weight



α-Amylase Inhibition Activity

SUELE demonstrated substantial α-amylase inhibitory activity. Percentage inhibition ranged from 74.26% to 80.04%, while acarbose exhibited inhibition ranging from 74.83% to 84.92%.

Sr. No.	Sample Code	Conc. µg/ml	Absorbance of sample(A)	Absorbance of control(C)	%inhibition of Alpha-amylase
1	Standard Acarbose	10	0.2188	0.8692	74.83%
		20	0.1912	0.8692	78.00%
		30	0.1708	0.8692	80.35%
		40	0.1590	0.8692	81.71%
		50	0.1311	0.8692	84.92%
2	Plant Extract	10	0.2237	0.8692	74.26%
		20	0.2042	0.8692	76.51%
		30	0.1986	0.8692	77.15%
		40	0.1844	0.8692	78.79%
		50	0.1735	0.8692	80.04%

(Plant Extract = Selenicereus undatus leaves extract)

α-Glucosidase Inhibition Activity

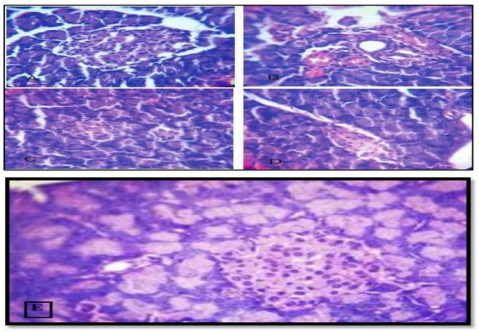
SUELE exhibited strong α-glucosidase inhibition ranging from 74.11% to 78.52%, compared with EGCG (75.68–82.33%).

Sr. No.	Sample Code	Conc. µg/ml	Absorbance of sample(A)	Absorbance of control(C)	%inhibition of Alpha-glucosidase
1	Standard EGCG (epigallocatechin gallate)	10	0.1921	0.7899	75.68%
		20	0.1793	0.7899	77.30%
		30	0.1696	0.7899	78.53%
		40	0.1521	0.7899	80.74%
		50	0.1396	0.7899	82.33%
2	Plant Extract	10	0.2045	0.7899	74.11%
		20	0.2006	0.7899	74.60%
		30	0.1927	0.7899	75.60%
		40	0.1822	0.7899	76.93%
		50	0.1697	0.7899	78.52%

(Plant Extract: Selenicereus Undatus Ethanolic Leaf Extract)

Histopathological Evaluation

Histopathological observations indicated pancreatic protection and partial restoration of tissue architecture in SUELE-treated groups compared with diabetic controls, suggesting preservationofβ-cellfunction.



Discussion

The present study demonstrates that ethanolic leaf extract of Selenicereus undatus possesses significant antidiabetic activity in both in vitro and in vivo models.The observed hypoglycemic effect may be attributed to the presence of flavonoids, phenolics, and saponins, which are known to improve glucose metabolism, reduce oxidative stress, and enhance insulin sensitivity.

The α-amylase and α-glucosidase inhibition assays showed that SUELE effectively suppresses

carbohydrate digestion and glucose absorption. These mechanisms contribute to the control of postprandial hyperglycemia, a critical therapeutic target in T2DM.

The STZ–nicotinamide model mimics several characteristics of human type 2 diabetes. The significant reduction in blood glucose levels and improvement in body weight observed following SUELE treatment suggest restoration of glucose homeostasis and improved metabolic function. The higher dose (200 mg/kg) exhibited greater efficacy, indicating a dose-dependent pharmacological response. Furthermore, histopathological findings suggest that SUELE may exert protective effects on pancreatic β-cells, potentially through antioxidant mechanisms mediated by its polyphenolic constituents. Overall, the findings support the traditional use of Selenicereus undatus and indicate its promise as a natural antidiabetic agent.

CONCLUSION

The ethanolic leaf extract of Selenicereus undatus demonstrated significant antidiabetic activity through both in vitro and in vivo investigations. The extract showed potent α-amylase and α-glucosidase inhibitory activities, reduced blood glucose levels, improved body weight, and exerted protective effects on pancreatic tissues in diabetic rats. These effects are likely attributable to its rich phytochemical composition, particularly flavonoids, phenolics, and saponins. The results support the potential development of Selenicereus undatus as a standardized herbal formulation for the management of type 2 diabetes mellitus.

So, further research is necessary because the ethanolic extract showed encouraging antidiabetic efficacy.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

All animal experiments were conducted in accordance with institutional animal ethics committee guidelines and CPCSEA regulations.

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