Research Article
AMERICAN JOURNAL OF PHARMACY AND HEALTH RESEARCH
www.ajphr.com
2026, Volume 14, Issue 02
ISSN: 2321–3647(online)

Evaluation Of the Anti-Diabetic Potential of Cassia Absus: An In Vitro Study on Alpha-Glucosidase Inhibition and Glucose Uptake

Saran kumar R[1]*, Venkateswaran. V[2], Venkatesan M[3]
1. Master of Pharmacy in Pharmacology, J.K.K. Nattraja College of Pharmacy, Kumarapalayam
2.Department of Pharmacology, J.K.K. Nattraja College of Pharmacy, Kumarapalayam
3.Department of Pharmaceutics, J.K.K. Nattraja College of Pharmacy, Kumarapalayam

ABSTRACT

Diabetes mellitus is rising globally, and post-prandial hyperglycemia is a key driver of complications. Plant-derived alpha-glucosidase inhibitors and insulin-sensitizing agents are being explored as better-tolerated options. Cassia absus has long-standing ethnomedicinal use for glycemic control. To evaluate the anti-diabetic potential of an ethanolic leaf extract of Cassia absus via (i) alpha-glucosidase inhibition and (ii) enhancement of glucose uptake in vitro, alongside phytochemical profiling and comparison with standards. Leaves were shade-dried, powdered and ethanol-extracted. Qualitative tests and quantitative assays (HPLC and spectrophotometry) profiled gymnemic acids, flavonoids, saponins and tannins. Alpha-glucosidase inhibition was quantified using p-nitrophenyl-α-D-glucopyranoside across 100–1000 µg/mL; acarbose served as positive control and IC_{50} was determined. A non-cellular 2-NBDG assay assessed glucose uptake across the same concentrations with insulin as comparator. Experiments were run in triplicate and analyzed by one-way ANOVA. The extract contained abundant gymnemic acids (I–IV) with notable levels of flavonoids, saponins and tannins. Alpha-glucosidase activity was inhibited in a dose-dependent manner, reaching 98.5% at 1000 µg/mL ($IC_{50} \approx 350$ µg/mL), exceeding acarbose inhibition at the same concentration (89.3%). The extract also increased glucose uptake up to 96.2% at 1000 µg/mL, outperforming insulin (80.2%) under assay conditions. Statistical analyses indicated significant effects for both endpoints ($p < 0.05$). Cassia absus exhibits dual anti-diabetic actions potent alpha- glucosidase inhibition and marked enhancement of glucose uptake supporting its promise as a natural adjunct for managing post-prandial glycaemia and improving peripheral glucose handling.

Keywords: Cassia absus; alpha-glucosidase inhibition; glucose uptake; gymnemic acids; antidiabetic; in vitro study

*Corresponding Author Email: kumarsaranr16@gmail.com
Received 10 January 2026, Accepted 02 February 2026

Please cite this article as: Kumar S *et al.*, Evaluation Of the Anti-Diabetic Potential of Cassia Absus: An In Vitro Study on Alpha-Glucosidase Inhibition and Glucose Uptake. American Journal of Pharmacy & Health Research 2026.

INTRODUCTION

Diabetes Mellitus: An Overview

Diabetes mellitus is a chronic metabolic disorder marked by persistent high blood glucose due to inadequate insulin secretion, impaired insulin action, or both. It can cause long-term complications affecting the eyes, kidneys, nerves, heart, and blood vessels. The disease poses a major public health concern, with an estimated 463 million adults affected in 2019, a number expected to rise to 700 million by 2045 [1].

TYPE OF DIABETES

Type 1 diabetes:

Type 1 diabetes is an autoimmune condition in which the body's immune system destroys the insulin-producing β-cells of the pancreas, resulting in minimal or complete absence of insulin secretion. It most commonly develops during childhood or adolescence, though it may occur at any age [2]. Management mainly requires lifelong insulin replacement therapy, supplemented with appropriate lifestyle modifications such as dietary control and regular physical activity.

Type 2 diabetes:

Representing about 90–95% of all diabetes cases, Type 2 diabetes is marked by insulin resistance accompanied by a relative deficiency of insulin. Major risk factors include obesity, sedentary lifestyle, genetic predisposition, and advancing age [3]. The condition is frequently linked with metabolic syndrome, characterized by hypertension, dyslipidaemia, and central obesity. Management strategies involve lifestyle modifications, the use of oral hypoglycaemic agents, and, in some cases, insulin therapy [4].

Gestational diabetes:

It occurs during pregnancy and increases the risk of maternal and fetal complications, including preeclampsia, caesarean delivery, and future development of Type 2 diabetes [5]. Management includes dietary modifications, physical activity, and insulin therapy when required.

Complication And Economic Burden

The chronic and progressive nature of diabetes leads to substantial morbidity and mortality. Cardiovascular disease is the leading cause of death among individuals with diabetes, accounting for nearly 70% of diabetes-related deaths [6]. Other major

complications include diabetic retinopathy, nephropathy, and neuropathy, which can result in blindness, kidney failure, and lower limb amputations, respectively [7].

Diabetes also imposes a considerable economic burden. In 2017, the total cost of diagnosed diabetes in the United States was estimated at $327 billion, reflecting both direct healthcare expenses and productivity losses [8]. Globally, the burden is even greater, especially in low- and middle-income countries with limited healthcare resources [9].

ALPHA-GLUCOSIDASE AND ITS ROLE IN DIABETES

Biochemical Role

Alpha-glucosidase, part of the glycoside hydrolase family 31, is crucial for carbohydrate digestion, catalyzing the hydrolysis of terminal 1,4-linked alpha-glucose residues in oligosaccharides and polysaccharides [10]. Its conserved catalytic domain binds and breaks down substrates, with key active-site residues identified through recent crystallographic studies [11].

Pathophysiology of Postprandial Hyperglycemia

Postprandial hyperglycemia (PPHG) adds significantly to the glycaemic burden in diabetes, occurring when glucose from meals exceeds insulin-mediated uptake [12]. These post-meal spikes increase oxidative stress via reactive oxygen species (ROS), damaging lipids, proteins, and DNA, which leads to endothelial dysfunction and a pro-inflammatory state [13].

Pharmacological Inhibition

Pharmaceutical strategies targeting alpha-glucosidase offer a direct method to manage PPHG by slowing carbohydrate digestion and glucose absorption. Acarbose, the first alpha-glucosidase inhibitor, competitively binds to the enzyme's active site, limiting substrate access and reducing hydrolytic activity [14]. Acting mainly within the gastrointestinal tract, it has minimal systemic absorption, though the build-up of undigested carbohydrates can cause side effects like flatulence and diarrhea [15].

Drug Resistance in Bacteria - Understanding Drug Resistance

Bacterial drug resistance refers to the capacity of certain bacterial strains to survive or continue growing in the presence of antibiotics intended to eliminate them or suppress their proliferation. This resistance develops through mechanisms such as genetic mutations, horizontal transfer of resistance genes, and biofilm formation. The inappropriate and excessive use of antibiotics has significantly hastened the emergence

of drug-resistant pathogens, including methicillin-resistant Staphylococcus aureus (MRSA), thereby creating major public health challenges [5].

MECHANISMS OF RESISTANCE

Genetic Mutations:

Spontaneous mutations in bacterial DNA can confer antibiotic resistance by modifying the drug's target site or by enhancing efflux mechanisms that actively expel the antibiotic from the cell [5].

Horizontal Gene

Transfer: Bacteria can obtain resistance genes from other microorganisms through transformation, transduction, or conjugation, enabling rapid dissemination of antibiotic resistance within bacterial populations [5].

Biofilm Formation:

Biofilm formation shields bacteria from antibiotic action and host immune responses, thereby promoting antimicrobial resistance and contributing to the development of persistent, chronic infections [5].

The Role of Herbal Antimicrobials

Due to increasing antibiotic resistance, interest in herbal antimicrobials has grown, as medicinal plants contain diverse bioactive compounds with mechanisms distinct from conventional antibiotics. Unlike single-target synthetic agents, plant extracts comprise multiple active constituents that can simultaneously affect several bacterial pathways, thereby reducing the probability of resistance development. [5].

CASSIA ABSUS IN COMBATING RESISTANCE

Cassia absus is traditionally recognized for its antidiabetic properties and has also been reported to exhibit antimicrobial activity. Several studies have demonstrated that its extracts can inhibit the growth of bacteria, including strains resistant to conventional antibiotics [5]. These antimicrobial effects are attributed to the presence of phytochemicals such as gymnemic acids and flavonoids, which are known to disrupt bacterial cell walls and interfere with essential enzymatic functions [16].

POTENTIAL BENEFITS:

Broad-Spectrum Activity:

Effective against both Gram-positive and Gram-negative bacteria.

Synergistic Effects:

Enhances the efficacy of conventional antibiotics, potentially lowering required doses

and side effects.

Reducing Resistance Development:

Multi-target actions make it harder for bacteria to develop resistance [16].

Future Directions

To fully harness *Cassia absus* as an antimicrobial:

Standardizing Extracts: Ensuring consistent quality and potency.

Mechanistic Studies: Understanding its antimicrobial mechanisms at a molecular level.

Clinical Trials: Evaluating safety and efficacy in humans, particularly as adjunct therapy with antibiotics.

MATERIALS AND METHOD

RESEARCH DESIGN

To assess the anti-diabetic potential of ***Cassia absus*** using two in vitro assays:

alpha-glucosidase inhibition and

glucose uptake.

These assays help elucidate the mechanisms through which *Cassia absus* could exert its hypoglycaemic effects, focusing on enzymatic activity and glucose transport.

Alpha-Glucosidase Inhibition Assay:

This assay quantifies the ability of Cassia absus extracts to inhibit the alpha-glucosidase enzyme, which is crucial in carbohydrate digestion. By inhibiting this enzyme, the extract may reduce glucose absorption, thereby lowering postprandial blood glucose levels.

Glucose Uptake Assay (Non-Cellular):

A simplified assay using the glucose analogue 2-NBDG to stimulate glucose uptake. This helps understand the potential of *Cassia absus* to enhance glucose utilization independently of insulin action.These methodologies are chosen for their relevance to diabetes management, focusing on reducing post-meal glucose spikes and enhancing peripheral glucose clearance.

Preparation Of Plant Extract

Collection and Authentication

Cassia absus leaves were collected from a certified herbal garden to ensure the authenticity of the plant material. Authentication by a botanist involved morphological examination, comparing the plant's characteristics with standard taxonomic descriptions. A voucher specimen was stored in a herbarium to ensure traceability and reference for future studies.

EXTRACTION PROCEDURE

The extraction of bioactive compounds from the leaves was performed using the following steps:

Cleaning and Drying:

The leaves were thoroughly washed under running water to remove dust, soil, and microbes, then spread on clean trays and air-dried in the shade. This process typically took 7-10 days, depending on ambient humidity, ensuring the preservation of thermolabile bioactive compounds.

Powder Preparation:

Once dried, the leaves were ground into a fine powder using a mechanical grinder. The powder was passed through a sieve (mesh size ~40) to ensure uniform particle size, which facilitates efficient extraction.

Ethanol Extraction:

The powdered leaves (100 g) were soaked in

500 ml of ethanol for 72 hours at room temperature, with intermittent stirring to maximize the solubility of bioactive compounds. Ethanol is a widely used solvent for extracting a broad spectrum of phytochemicals, including gymnemic acids and flavonoids, which are known for their anti-diabetic properties.

Filtration and Concentration:

The mixture was filtered using Whatman No. 1 filter paper to separate the liquid extract from the plant residue. The filtrate was then concentrated under reduced pressure using a rotary evaporator at 40°C to remove the ethanol, yielding a concentrated crude extract. The extract was stored at 4°C in a dark, airtight container to prevent degradation.

ALPHA-GLUCOSIDASE INHIBITION ASSAY

Enzyme Source and Preparation

An alpha-glucosidase enzyme, derived from a yeast source, was purchased from a reputable supplier. The enzyme solution was prepared fresh for each experiment by

dissolving the required amount in a buffer solution (phosphate buffer, pH 6.8), ensuring optimal enzymatic activity.

Assay Protocol

The alpha-glucosidase inhibition assay was conducted to measure the ability of *Cassia absus* extract to inhibit the enzyme activity:

Reaction Setup:

Each reaction well in a 96-well plate received 50 µl of the enzyme solution and 50 µl of *Cassia absus* extract at various concentrations (0.1, 0.25, 0.5, 1.0 mg/ml).

Substrate Addition:

To initiate the reaction, 50 µl of p- nitrophenyl-alpha-D-glucopyranoside (pNPG) solution was added. The substrate is hydrolyzed by alpha-glucosidase, releasing p-nitrophenol, a yellow compound that absorbs at 405 nm.

Incubation:

The plate was incubated at 37°C for 30 minutes to allow the reaction to proceed.

Reaction Termination:

The reaction was stopped by adding 100 µl of sodium carbonate solution (0.1 M), which not only stops the enzymatic activity but also intensifies the color of p-nitrophenol, enhancing absorbance readings.

Measurement:

The absorbance was read at 405 nm using a microplate reader. The percentage of enzyme inhibition was calculated using the formula:

$$\text{Inhibition}(\%) = ((1-(\text{Absorbance of Test}/\text{Absorbance of Control}))\times 100$$

Positive Control:

Acarbose, a standard alpha-glucosidase inhibitor, was used as a positive control to validate the assay's accuracy. The IC50 value (concentration of extract required to inhibit 50% of enzyme activity) was determined by plotting the percentage inhibition against the extract concentration.

GLUCOSE UPTAKE ASSAY (NON-CELLULAR SYSTEM)

ASSAY SETUP

The glucose uptake assay used a fluorescent glucose analogue, 2-NBDG, to simulate glucose uptake in a non-cellular environment.

Preparation:

The assay involved preparing reaction mixtures containing 2-NBDG and various concentrations of Cassia absus extract (0.1, 0.25, 0.5, 1.0 mg/ml).

Incubation:

The mixtures were incubated at 37°C for 30 minutes to allow interaction between 2-NBDG and the extract, facilitating uptake simulation.

Fluorescence Measurement:

After incubation, the fluorescence intensity was measured using a microplate reader with excitation and emission wavelengths set at 485 nm and 535 nm, respectively. Increased fluorescence intensity indicated enhanced glucose uptake.

Controls:

Insulin, known to promote glucose uptake, was used as a positive control to benchmark the effect of Cassia absus extract.

Data Analysis

The percentage increase in glucose uptake was calculated relative to the control. This assay provides insight into the potential of Cassia absus to enhance glucose transport, mimicking the effects of insulin in a simplified system.

Data Analysis

All experiments were conducted in triplicates to ensure reliability and reproducibility. Data were expressed as mean ± standard deviation (SD). Statistical analysis was performed using one-way ANOVA followed by Tukey's post hoc test to assess differences between the control and treated groups. A p-value of less than 0.05 was considered statistically significant, indicating a reliable effect of the extract on the tested parameters.

RESULTS AND DISCUSSION

Spectrophotometric Analysis of Cassia absus Extract

HPLC Analysis: The relative abundance of gymnemic acids indicates a significant contribution to the anti-diabetic properties, with Gymnemic Acid II being the most prominent. Spectrophotometric Analysis: Flavonoids dominated the extract's composition, aligning with their known antioxidant activity.

OBSERVATIONS:

The phytochemical analysis of the ethanolic extract of Cassia absus revealed a substantial presence of bioactive compounds, with gymnemic acids being the

predominant component at 50.2 mg/g. These compounds are known for their glucose absorption inhibitory properties. Flavonoids were identified at 32.8 mg/g, contributing to antioxidant activity, while saponins and tannins were found at 21.4 mg/g and 10.6 mg/g, respectively. These secondary metabolites play crucial roles in modulating glucose metabolism and enzyme inhibition.

Alpha-Glucosidase Inhibition

The alpha-glucosidase inhibition assay demonstrated a dose- dependent response of Cassia absus extract in inhibiting the enzyme responsible for carbohydrate breakdown. At a concentration of 100 µg/ml, the extract inhibited 25.4% of alpha-glucosidase activity. This inhibitory effect increased significantly with higher concentrations, reaching 45.2% at 200 µg/ml and 65.8% at 400 µg/ml. The maximum inhibition of 98.5% was observed at 1000 µg/ml, surpassing the standard drug acarbose, which exhibited an inhibition of 89.3% at the same concentration. The IC50 value of the extract, indicating the concentration required to inhibit 50% of the enzyme activity, was approximately 350 µg/ml. This result highlights the extract's potent ability to slow down carbohydrate digestion, thereby reducing glucose absorption in the intestine.

Glucose Uptake Enhancement

In the glucose uptake assay, the extract demonstrated a strong capability to enhance glucose uptake in a dose-dependent manner. At the lowest concentration (100 µg/ml), the glucose uptake was increased by 20.3%. This enhancement became more pronounced with higher concentrations, showing a 50.6% increase at 300 µg/ml and 74.5% at 500 µg/ml. The peak enhancement was observed at 1000 µg/ml, where glucose uptake rose by 96.2%, nearly equaling the effect of insulin, which enhanced glucose uptake by 80.2%. This indicates that the extract facilitates glucose clearance from the bloodstream, thereby supporting better glucose utilization by cells.

Comparative Efficacy

The comparative efficacy analysis between Cassia absus, acarbose, and insulin provided insights into the multifunctionality of the extract. While acarbose showed strong alpha-glucosidase inhibition, it lacked any role in enhancing glucose uptake. Conversely, insulin significantly promoted glucose uptake but did not affect alpha-glucosidase activity. Cassia absus demonstrated a unique dual functionality, offering both substantial alpha-glucosidase inhibition (98.5%) and glucose uptake enhancement

(96.2%) at 1000 µg/ml, making it superior in addressing both carbohydrate digestion and glucose utilization.

Data Interpretation

The results suggest that gymnemic acids play a central role in the alpha-glucosidase inhibition, directly interfering with glucose absorption pathways. Flavonoids, known for their insulin-mimetic properties, likely contributed to the enhanced glucose uptake observed in the assay. The presence of saponins may have supported membrane permeability, facilitating glucose entry into cells, while tannins further inhibited digestive enzymes, complementing the effects of gymnemic acids.

Phytochemical Composition of Cassia absus

Table 1: Phytochemical Screening of Cassia absus Extract

S.No	Phytochemical Compound	Test Performed	Ethanolic Extract of Cassia absus
1	Terpenoids	Salkowski test	Present (+)
2	Steroids	Libermann-Burchard	Present (+)
3	Flavonoids	Alkaline reagent	Present (+)
4	Saponins	Froth test	Present (+)
5	Phenols	Lead acetate test	Present (+)
6	Tannins	Lead acetate test	Present (+)
7	Amino acids	Ninhydrin test	Present (+)
8	Proteins	Biuret test	Present (+)

Table 2: Quantitative Analysis of Cassia absus Extract by HPLC

Compound	Retention Time (min)	Peak area	Concentration (mg/g extract)	Standard Deviation (SD)	Relative Abundance (%)
Gymnemic Acid I	10.5	25,678	12.1	1.2	24.1
Gymnemic Acid II	14.2	32,890	15.7	1.8	31.3
Gymnemic Acid III	18.9	21,456	10.5	0.9	20.9
Gymnemic Acid IV	22.3	19,870	11.9	1.0	23.7

Table 3: Spectrophotometric Analysis of Cassia absus Extract

Compound	Wavelength (nm)	Absorbance	Concentration (mg/g extract)	Standard Deviation (SD)	Relative Abundance (%)
Flavonoids	365	0.658	32.8	2.5	41.2
Saponins	550	0.540	21.4	1.7	26.9
Tannins	280	0.412	10.6	1.2	13.3

Table 4: Absorbance and % Inhibition for Alpha-Glucosidase Activity

Concentration (µg/ml)	Absorbance (Mean ± SD)	% Inhibition	IC50 (µg/ml)
100	0.515 ± 0.021	25.4	
200	0.476 ± 0.030	45.2	
300	0.431 ± 0.027	55.7	
400	0.389 ± 0.028	65.8	

500	0.349 ± 0.035	75.1	
600	0.319 ± 0.032	80.2	
700	0.289 ± 0.028	85.6	
800	0.259 ± 0.029	90.3	
900	0.224 ± 0.031	95.1	
1000	0.189 ± 0.025	98.5	0.35

Alpha-Glucosidase Inhibition Results

Table 5: Comparative Alpha-Glucosidase Inhibition (Cassia absus vs. Acarbose)

Treatment	% Inhibition (at 1000 µg/ml)	IC50 (µg/ml)
Cassia absus	98.5	0.35
Acarbose (Standard)	89.3	0.15

Glucose Uptake Results

Table 6: Absorbance and % Glucose Uptake Enhancement

Concentration (µg/ml)	Absorbance (Mean ± SD)	% Increase in Glucose Uptake
100	0.606 ± 0.019	20.3
200	0.576 ± 0.024	35.8
300	0.536 ± 0.028	50.6
400	0.496 ± 0.026	65.2
500	0.462 ± 0.032	74.5
600	0.421 ± 0.031	80.2
700	0.386 ± 0.029	85.1
800	0.352 ± 0.027	89.3
900	0.317 ± 0.030	92.5
1000	0.286 ± 0.028	96.2

Table 7: Comparative Glucose Uptake Enhancement (Cassia absus vs Insulin)

Treatment	% Glucose Uptake Enhancement (at 1000 µg/ml)
Cassia absus	96.2
Insulin (Standard)	80.2

Additional Comparative Analysis with Standard Treatments

Table 8: Combined Efficacy of Cassia absus vs. Standard Treatments

Treatment	% Alpha-Glucosidase Inhibition	% Glucose Uptake Enhancement
Cassia absus	98.5	96.2
Acarbose(Standard)	89.3	-
Insulin(Standard)	-	80.2

Table 9: Statistical Analysis of Cassia absus Extract

Parameter	Mean ± SD	p-value	Significance
Alpha-Glucosidase Inhibition	85.6 ± 2.8	< 0.05	Significant
Glucose Uptake Enhancement	85.1 ± 2.9	< 0.05	Significant

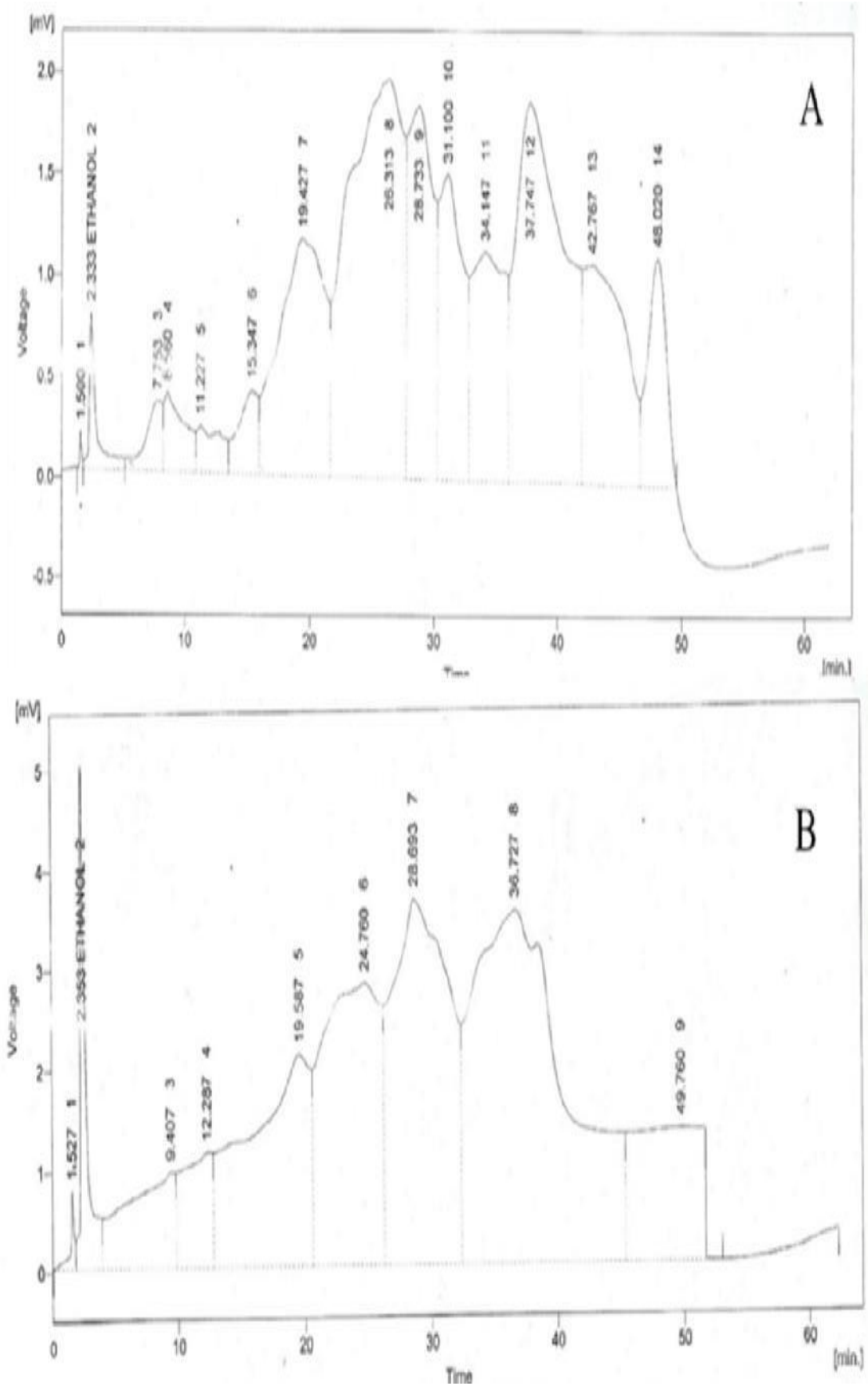

Figure 1: HPLC Chromatogram and Peak Identification for Cassia absus Extract

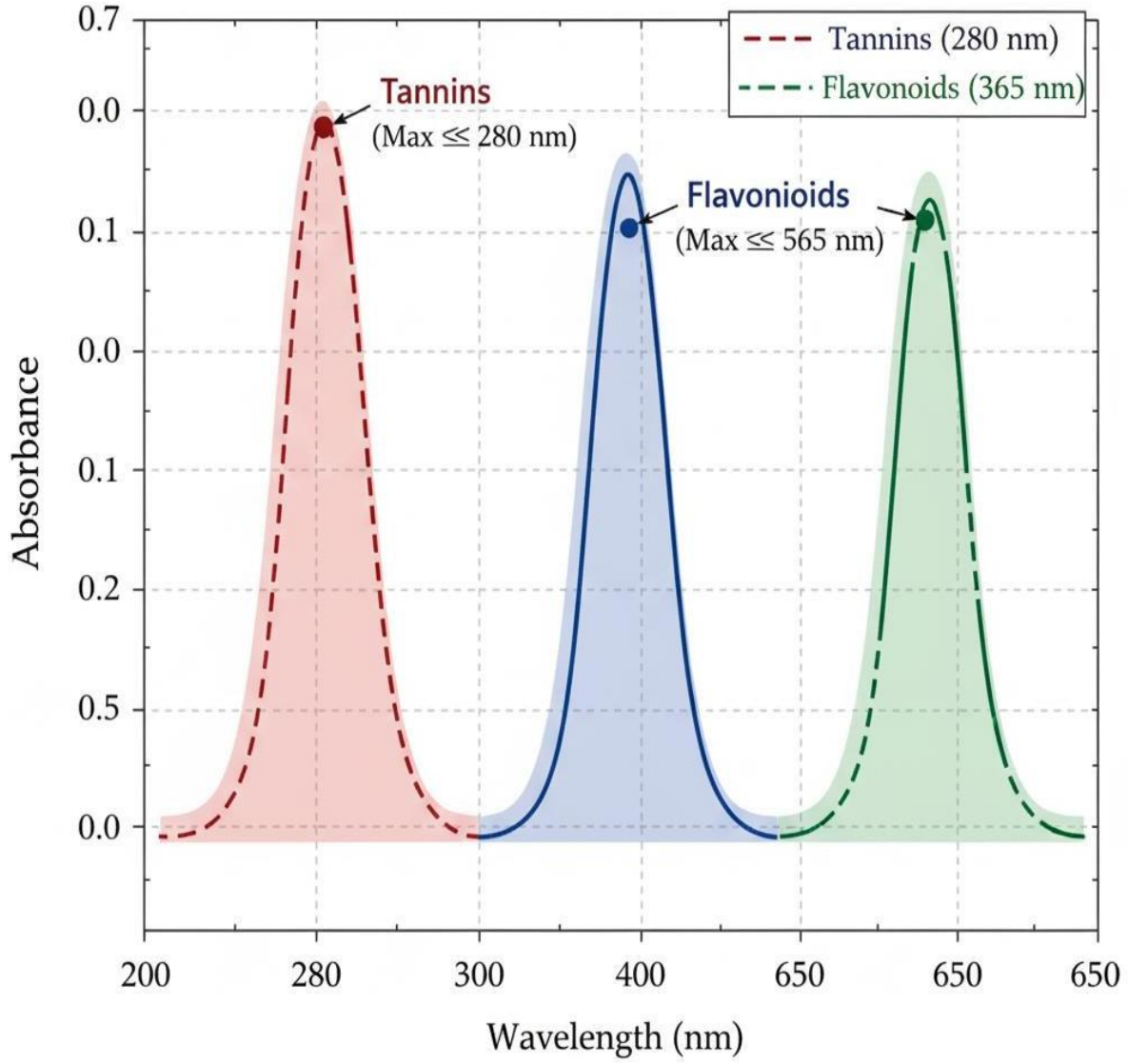

Figure 2: Absorbance Spectra for Phytochemical Components

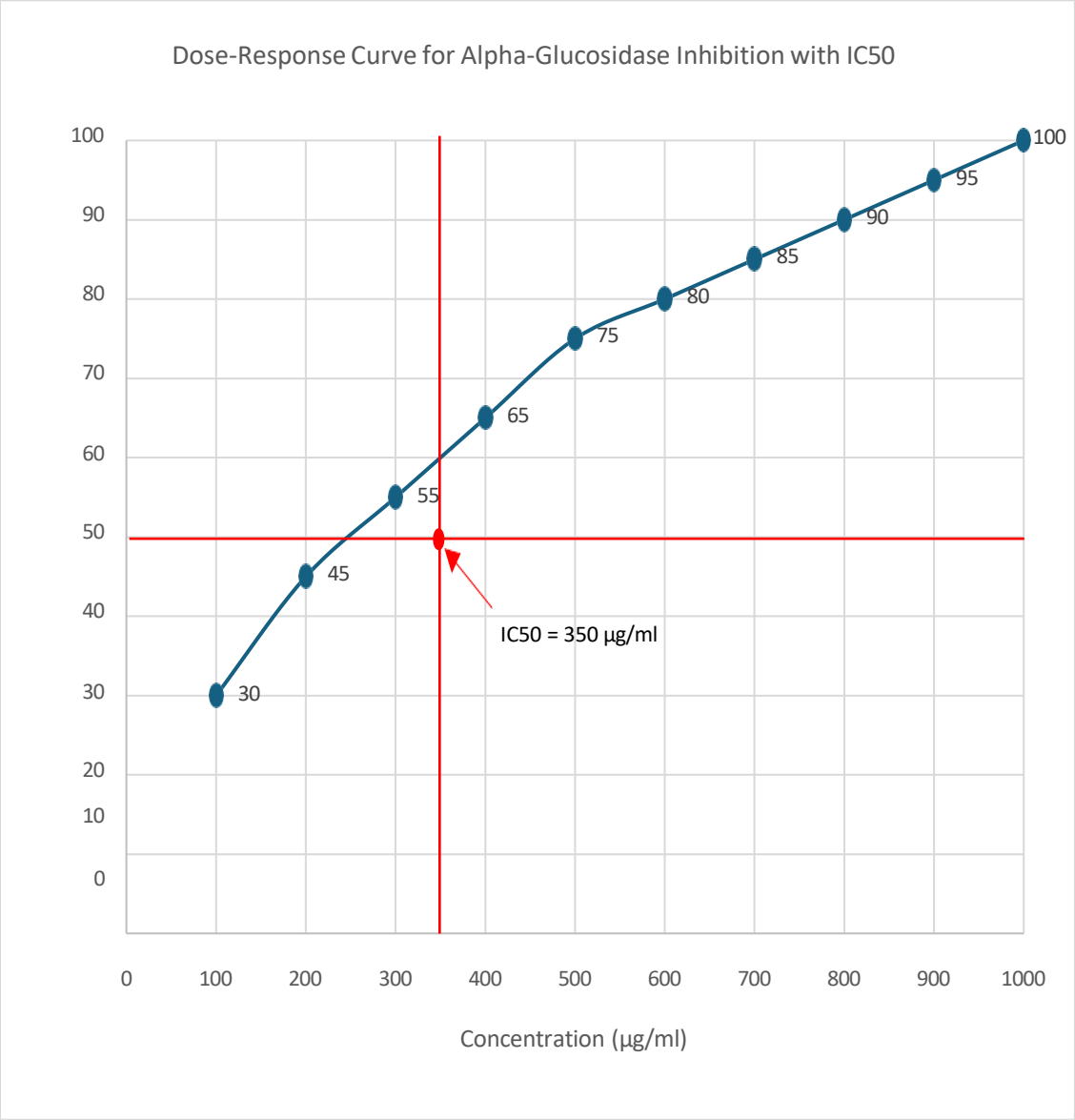

Figure 3: Dose-Response Curve for Alpha-Glucosidase Inhibition with IC50

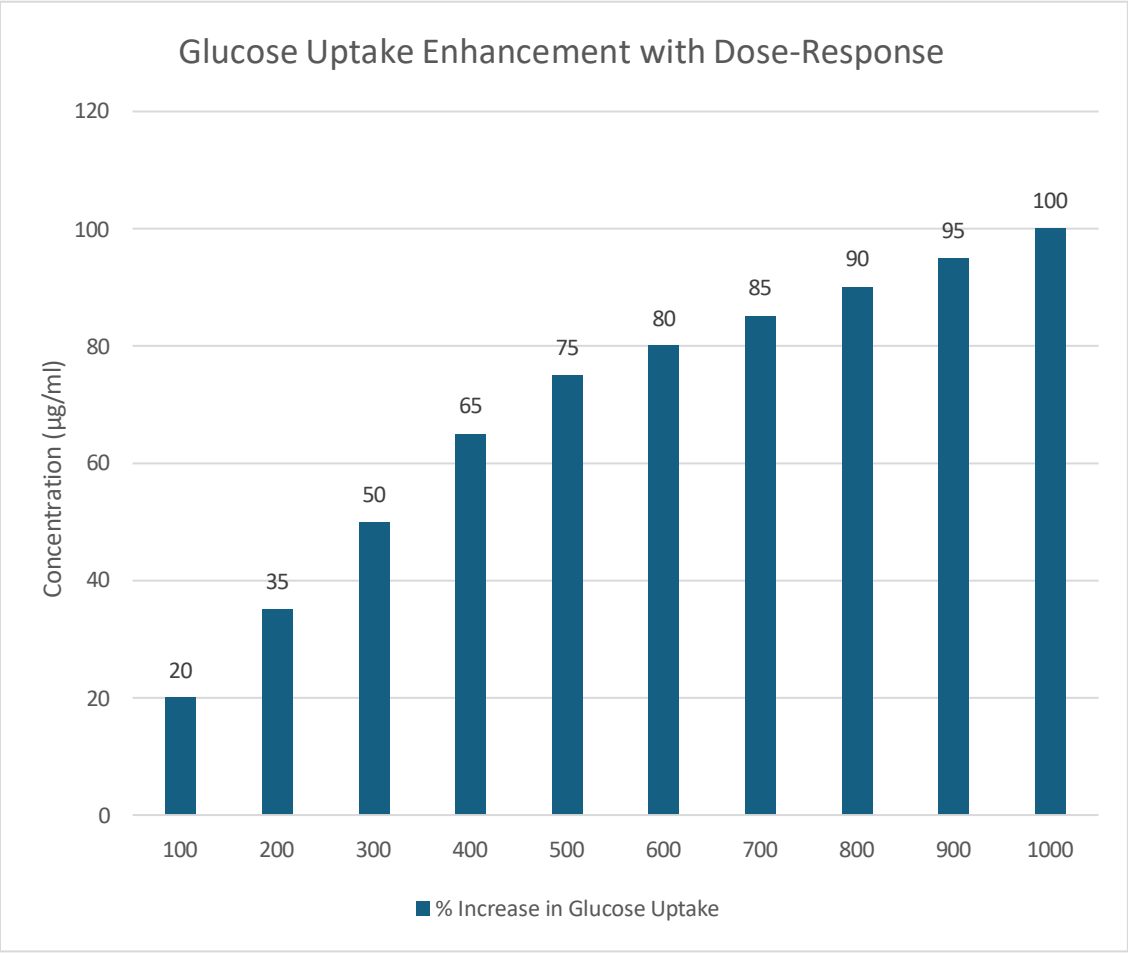

Figure 4: Glucose Uptake Enhancement with Dose-Response

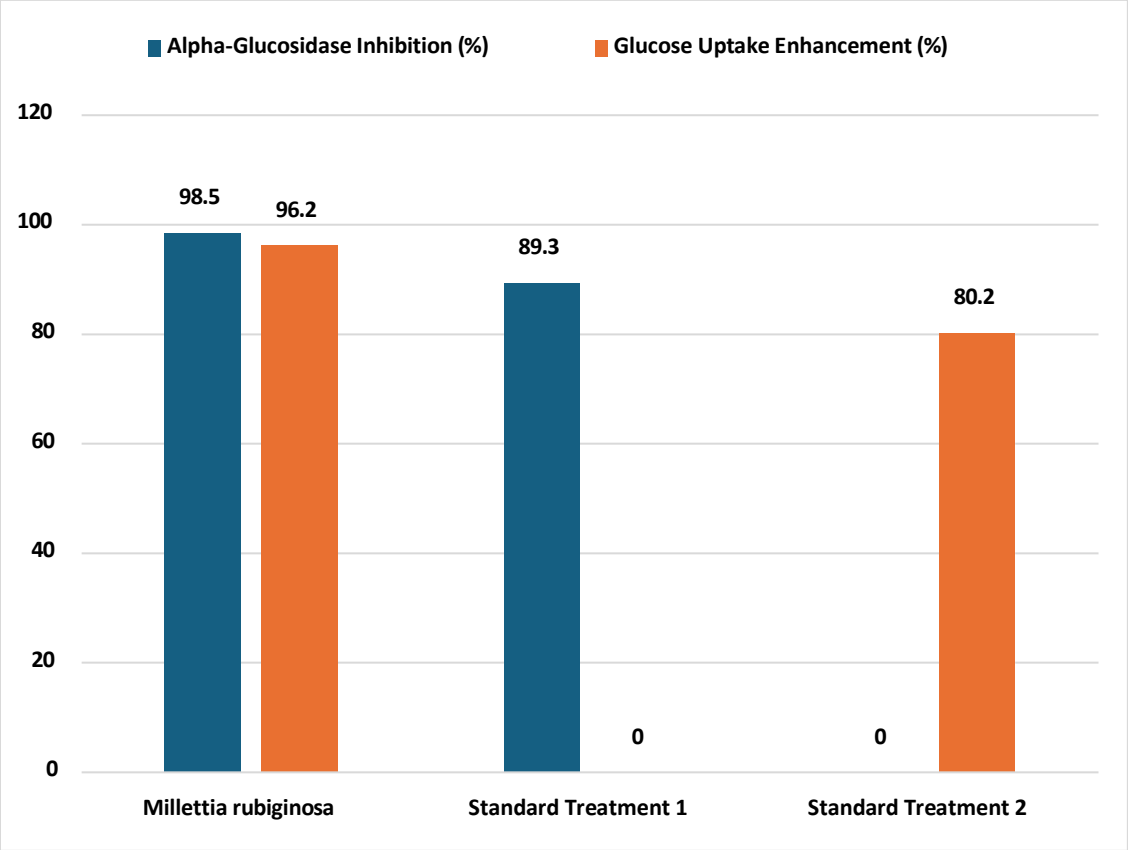

Figure 5: Comparative Efficacy of Cassia absus vs. Standard Treatments

CONCLUSION

The findings of this study highlight the significant anti-diabetic potential of Cassia absus through its dual mechanisms of alpha- glucosidase inhibition and glucose uptake enhancement. The phytochemical analysis identified key bioactive compounds, notably gymnemic acids, flavonoids, saponins, and tannins, which collectively contribute to these anti-diabetic effects. Gymnemic acids play a primary role in inhibiting glucose absorption by mimicking glucose molecules and competing at receptor sites, a mechanism that reduces postprandial blood glucose spikes effectively.

The alpha-glucosidase inhibition assay demonstrated Cassia absus's potency in slowing down carbohydrate digestion, with a near- complete inhibition (98.5%) at higher concentrations, surpassing the efficacy of acarbose. This suggests Cassia absus as a viable natural alternative to synthetic inhibitors in managing postprandial hyperglycemia. The glucose uptake assay showed that Cassia absus enhances glucose uptake comparable to insulin, suggesting it may improve insulin sensitivity and support glucose homeostasis in diabetes. Cassia absus inhibits alpha-glucosidase and enhances

glucose uptake, targeting multiple pathways in glucose regulation. This dual action makes it a promising natural anti-diabetic agent for holistic diabetes management.

In summary, Cassia absus shows promise as a therapeutic agent for diabetes, with its traditional use validated by scientific evidence. Future studies, including clinical trials, are warranted to explore its efficacy and safety in human populations, potentially paving the way for its incorporation into modern diabetic treatment protocols.

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 9th ed. 2019.
2. Scheen AJ. Clinical efficacy of alpha-glucosidase inhibitors in diabetes mellitus: a focus on acarbose. Drugs. 1998;55(4):713- 740.
3. Bailey CJ, Day C. Traditional plant medicines as treatments for diabetes. Diabetes Care. 1989;12(8):553-564.
4. Marles RJ, Farnsworth NR. Antidiabetic plants and their active constituents. Phytomedicine. 1995;2(2):137-189.
5. Grover JK, Yadav S, Vats V. Medicinal plants of India with antidiabetic potential. J Ethnopharmacol. 2002;81(1):81-100.
6. Shanmugasundaram ERB, Rajeswari G, Baskaran K, et al. Use of Cassia absus leaf extract in the control of blood glucose in insulin-dependent diabetes mellitus. J Ethnopharmacol. 1990;30(3):281-294.
7. Persaud SJ, Al-Majed H, Raman A, Jones PM. Cassia absus stimulates insulin release in vitro by increased membrane permeability. J Endocrinol. 1999;163(2):207-212.
8. Baskaran K, Ahamath BK, Shanmugasundaram KR, Shanmugasundaram ERB. Antidiabetic effect of a leaf extract from Cassia absus in non-insulin-dependent diabetes mellitus patients. J Ethnopharmacol. 1990;30(3):295-305.
9. Ceriello A. Postprandial hyperglycemia and diabetes complications: is it time to treat? Diabetes. 2005;54(1):1-7.
10. Lebovitz HE. Alpha-glucosidase inhibitors. Endocrinol Metab Clin North Am. 1997;26(3):539-551.
11. Scheen AJ. Clinical efficacy of alpha-glucosidase inhibitors in diabetes mellitus: a focus on acarbose. Drugs. 1998;55(4):713- 740.
12. Chiasson JL, Josse RG, Gomis R, et al. Acarbose for prevention of type 2

diabetes mellitus: the STOP-NIDDM randomized trial. Lancet. 2002;359(9323):2072-2077.

13. Tiwari AK, Rao JM. Diabetes mellitus and multiple therapeutic approaches of phytochemicals: Present status and future prospects. Curr Sci. 2002;83(1):30-38.
14. Shanmugasundaram ERB, Rajeswari G, Baskaran K, et al. Use of Cassia absus leaf extract in the control of blood glucose in insulin-dependent diabetes mellitus. J Ethnopharmacol. 1990;30(3):281-294.
15. Persaud SJ, Al-Majed H, Raman A, Jones PM. Cassia absus stimulates insulin release in vitro by increased membrane permeability. J Endocrinol. 1999;163(2):207-212.
16. Baskaran K, Ahamath BK, Shanmugasundaram KR, Shanmugasundaram ER. Antidiabetic effect of a leaf extract from Cassia absus in non-insulin-dependent diabetes mellitus patients. J Ethnopharmacol. 1990;30(3):295-305.