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Research Article

Anti Diabetic Activity of *Ipomoea quamoclit L.* in Streptozotocin Induced Diabetic Rats

Raveendra Reddy Juturu[1], Sanjeeva Kumar Avvari[2]*, Rama Mohan Gupta Vankadari[3]

1. Raghavendra Institute of Pharmaceutical Education and Research (Autonomous), Krishnam Reddy Palli cross, Chiyyedu, Anantapuramu-515721, Andhra Pradesh, India.
2. Amity Institute of Pharmacy, Amity University Bengaluru, Opp. to Bengaluru Rural DC Office, NH - 648, Devanahalli - Doddaballapura Road, Bengaluru, Karnataka - 562 110, India.
3. Pulla Reddy Institute of Pharmacy, Near Dundigal Air Force Academy, Annaram Village, Jinnaram Mandal, Medak District- 502313, Telangana, India.

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Abstract

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycaemia and dyslipidaemia, leading to serious vascular complications. The present study evaluated the antidiabetic and antidyslipidaemic potential of the hydroalcoholic extract of *Ipomoea quamoclit L.* whole plant in streptozotocin (STZ)-induced diabetic wistar rats. The hydroalcoholic extract derived from the whole plant of *Ipomoea quamoclit L.* (HAIQ) was subjected to acute toxicity and gross behavioral assessment in Swiss albino mice. Diabetes was induced by a single intraperitoneal injection of STZ (55 mg/kg). Diabetic rats were treated orally with the extract at doses of 250 mg/kg and 500 mg/kg for 30 days, while glibenclamide (10 mg/kg) served as the standard drug. Fasting blood glucose levels were monitored periodically, and serum lipid profile parameters along with body weight were assessed at the end of the study. No signs of toxicity or deaths were recorded at any of the tested doses, indicating a favorable safety profile of the extract. Treatment with the extract produced a significant and dose-dependent reduction in fasting blood glucose levels ($p < 0.001$). It also significantly improved lipid parameters by reducing triglycerides, total cholesterol, LDL, and VLDL levels while increasing HDL concentrations ($p < 0.05$ to $p < 0.001$). Furthermore, the extract prevented diabetes-induced body weight loss. The higher dose (500 mg/kg) exhibited greater efficacy, with effects comparable to glibenclamide. These findings suggest that *Ipomoea quamoclit L.* possesses significant antidiabetic and antihyperlipidemic activity and may serve as a promising natural therapeutic candidate for diabetes management.

Keywords: Antidiabetic activity, Streptozotocin, Lipid profile, Herbal extract.

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Introduction

Diabetes mellitus refers to a chronic metabolic condition denoted by the sustained hyperglycemia because of hindered secretion or activities of insulin or a combination of the competition(1-3). It affects mostly carbs, fats and proteins metabolism. The pathology can be divided into four main divisions as Type 1 diabetes (T1DM) and Type 2 diabetes (T2DM), gestational diabetes mellitus (GDM), and other special types caused by genetic abnormalities or secondary causes (examples are pancreatitis and medication-induced). Type 1 diabetes is an auto-immunocomplex disorder normally detected in childhood and among the young adults when the body immune system activates to kill the pancreatic B-cells, causing the deficiency of insulin entirely. Type 2 diabetes, in turn, is more widespread and connected with insulin resistance and relative insulin deficiency, often related to obesity, inactive lifestyle and heredity. During pregnancy, GDM tends to clear up after giving birth yet predisposes a person to the development of T2DM later in life. Only proper classification is needed in order to manage and prognosticate accurately(4-6).

The problem of diabetes is an increasing trend in the world with more than 537 million cases throughout the world in 2021 and the numbers are expected to increase to 643 million by 2030(7). Urbanization, poor diets, and a lack of physical activity have resulted in an unequal burden in low- and middle-income countries. Diabetes leads to great impairment of the quality of life and causes more complications than cardiovascular disease, nephropathy, retinopathy, and neuropathy. This leads to increased mortality and disability-adjusted life years (DALYs) because of these complications(8). Economically, the disease presents

*** Corresponding Author:**
Sanjeeva Kumar Avvari
Associate Professor, Amity Institute of Pharmacy, Amity University Bengaluru, Opp. to Bengaluru Rural DC Office, NH - 648, Devanahalli - Doddaballapura Road, Bengaluru, Karnataka - 562 110, India.
Email Id: avvarisanjeev@gmail.com

enormous health care costs to any health care system with the 2021 global health expenditure on diabetes being an estimated of 966 billion dollars USD. People have to spend too much of their own money on paying medicine, surveillance, and dealing with complications. In addition, there will be a decrease in productivity when an individual gets sick or dies prematurely, which hurts the economies of countries(9). Direct medical expenses depend on the treatment but the indirect costs fall most of the times higher than the direct costs thus the need to prevent, detect early and the need to develop effective treatment plans that are cost-effective.

Current Treatment Approaches and Limitations

The lifestyle change, oral hypoglycemic drugs (such as metformin, sulfonylureas, and DPP-4 inhibitors), insulin, newer agents (SGLT2 inhibitors, GLP-1 receptor agonists), and the combination are the main components of existing diabetes management(10, 11). Although these pharmacologic agents are good in managing blood glucose, they are associated with limitations. Several drugs may entail various side effects like loss of appetite, an increase in weight, gastrointestinal-related inconveniences, and even cardiovascular dangers. In addition, there is progressive destruction of β-cells, which complicate glycemic control in chronic diabetes (Type 1 and 2 diabetes). Insulin treatment, which is necessary in Type 1 and severe Type 2 diabetes, requires strict control, and is at times tiresome to the patient(12, 13). There is also cost and access to medication, which prevents adherence and outcomes in low-resource areas. There has been a general attraction towards the practice of alternative and complementary medicines particularly the ones that have plants as their main component since they are usually cheaper and socially acceptable. Plants are actively being tested as having potential in normalizing blood glucose levels, enhancing insulin sensitivity, and treatment of comorbid conditions such as dyslipidemia, thus overcoming the shortcomings of the modern treatments available.

Role of Oxidative Stress and Dyslipidemia in Diabetes

Pathophysiology of Hyperglycemia-Induced Oxidative Stress

Chronic hyperglycemia that occurs in diabetes mellitus causes overproduction of reactive oxygen species (ROS), which overwhelms the natural antioxidant protection system triggering the development of oxidative stress(14, 15). High glucose increases the generation of superoxide in mitochondria and induction of various potentially dangerous pathways, including polyol pathway, protein kinase C pathway, and advanced glycation end products (AGEs)(14). These pathways lead to tissue damage of different organs, endothelial dysfunction, and inflammation. Oxidative stress is important in initiation and deterioration of the diabetic complications like nephropathy, retinopathy, and neuropathy(16). Also, this damages pancreatic beta-cells promoting oxidative damage, which in turn, fails to secrete insulin causing vicious cycle. The role of oxidative stress in the pathophysiology of diabetes warrants the use of antioxidant-based strategies, thus offering herbal as opposed to pharmaceutical interventions a potential role to play in addressing the balance between the oxidation of the redox cycle.

Importance of Managing Lipid Abnormalities in Diabetic Patients

One of the frequent metabolic disorders in diabetes is dyslipidemia which is a state of too much triglyceride and elevated levels of low-density lipoprotein (LDL) and too little high-density lipoprotein (HDL). These disorders are major causers of cardiovascular disease, which poses serious risks to the life of diabetic persons. The growth of VLDL is out of control because of insulin resistance that also deregulates the metabolism of lipoprotein production so that the liver tends to overproduce it. As a result, there is a tendency to find atherogenic lipid profiles in patients having uncontrolled diabetes. The control of these lipid disorders plays an important role in the macrovascular complication prevention of coronary artery disease and strokes. Conventional treatment includes lifestyle changes, statins, fibrates, and omega-3 fatty acids, although natural compounds derived medicinal plants proved to have excellent lipid-lowering properties as well. Isolates with hypoglycemic and hypolipidemic effects are especially important, since they can resolve several defects in metabolic processes at once, which significantly increases the level of patient health and minimizes the development of further complications(17, 18).

Interrelationship Between Glucose Metabolism and Lipid Profile

Glucose and lipid metabolism are closely related and imbalance in one of the pathways tends to influence the other. Insulin is the chief figure in context to the two processes which accentuate glucose uptake and averts lipolysis. The inhibition of insulin results in elevated lipolysis and production of free fatty acids in adipose tissue in insulin resistant conditions (Type 2 diabetes). These free fatty acids will worsen hepatic production of glucose and cause insulin resistance, worsening the regulation of glucose production. At the same time, they become the substrate of the formation of triglycerides, which causes hypertriglyceridemia and an increase in the content of VLDL. On the other hand, consistent elevated glucose levels have the potential to alter the shape and functionality of lipoproteins leading to endothelial dysfunction and atherogenesis. Therefore, a change in a lipid profile does not merely indicate a loss of metabolic control but also deteriorates a glycemic status. The two-way association shows the need of combined treatments that normalize glucose and lipids. Dual action herbal therapies which affect both glycemic and therapeutic control are becoming more popular with the holistic advantage they offer in management of diabetics(19, 20).

Ipomoea quamoclit L. – Botanical and Ethnomedicinal Profile

Taxonomy: Family Convolvulaceae, Common Names

This genus, *Ipomoea quamoclit L.* L., is a member of the family *Convolvulaceae* that has several medicinally useful species. It is a vigorous, twining, slender-stemmed herb, with finely-divided leaves, and star-shaped, brilliant red flowers, much like those of the maclura; and is commonly called Cypress Vine, Star Glory, or Kamala. It is native of tropical America but became naturalized today in most of the parts of Asia, Africa, and India. The shrub naturally grows in fences and gardens. Although it is regarded as an ornamental plant, a lot of rural common activities use the parts of the plant in some form of therapy, thus preconditioning the pharmacological study(21).

Traditional Uses in Various Cultures (Focus on Diabetes if Mentioned)

The extensive traditional use In *Ipomoea quamoclit L.* in traditional medicine systems like Ayurveda as well as folk practices is evidenced. The plant is normally used as a vermifuge, febrifuge, laxative, and to treat inflammations and wounds and gastro intestinal disorders(3). Its aerial parts Decoctions or infusions are employed in some parts of India, and in Singapore and other districts of Southeast Asia, to treat fever and skin disorders(22). Inflammatory and metabolic more severe symptoms can be handled with it, and although there are not more direct references to its application in diabetes, this factor shows its possible applicability(23). This kind of ethnomedicinal evidence shall serve as a basis of scientific studies on its antidiabetic potential.

Phytochemical Constituents Reported in Literature (Alkaloids, Flavonoids, Saponins, etc.)

Phytochemical studies of *Ipomoea quamoclit L.* have demonstrated a proficient repository of bioactive elements. Alkaloids, flavonoids, glycosides, saponins, tannins, triterpenoids, and phenolic compounds are found in the plant, several of these compounds linked to antidiabetic, antioxidant, and anti-inflammatory effects. Specifically, flavonoids and phenolics by virtue of their free radical scavenging properties may help prevent oxidative stress during diabetic states. Saponins and alkaloids have been cited to have effects on the glucose metabolism and insulin sensitivity. The cosmopolitan chemical structure favors this medicinal value of the plant and offers a biochemical explanation to the pharmacological activities it is known to exhibit(24, 25).

Rationale for Selecting This Plant for the Study

The best part of the decision to select the *Ipomoea quamoclit L.* for the current study is not only due to its good ethnomedicinal prospects but due to the wide availability and the abundance of phytochemical profile. Despite its traditional applications and bioactive components, not many scientific papers have tested its possible role in the management of diabetes by employing validated *in vivo* models(26). Since the plant has antioxidant-rich phytochemistry and testimonial health properties, it would make a good choice to test in antidiabetic property. The idea of investigating underexploited medicinal plants is also appropriate given the quest the world has directed towards finding new, cheap and nontoxic phytotherapeutic drugs to help care about chronic conditions such as diabetes mellitus(21).

Use of Streptozotocin (STZ) as a Diabetogenic Agent: Mechanism and Reliability

Streptozotocin (STZ) is a natural compound of the nitrosoureas family and produced by Streptomyces achromogenes; it has been used extensively to produce experimental diabetes in animals(27). It is highly selective against pancreatic 2-B cells, and in this regard, it is because of its selectivity to the glucose transporter, as it targets GLUT2 which is lethal to the cell as it alkylates cell DNA, causes oxidative stresses, and ultimately also results in cell necrosis(28). This leads to the deficiency of insulin and continuous hyperglycemia simulating Type 1 or Type 2 diabetes depending on the dose and plan. STZ is recognized as an effective and reproducible model of investigating the antidiabetic compounds with its metabolic and pathophysiological changes that closely mimic human diabetes such as insulin resistance, weight loss, and dyslipidemia(29).

Justification for Selecting STZ-Induced Diabetic Rats in This Study

Diabetic rat model (STZ) in this study was selected because it has been used successfully in the past to reproduce several salient attributes of human diabetes, such as hyperglycemia, weight loss and lipid alterations. Such a model allows controlled induction of diabetes so that a regular assessment of antidiabetic potential of botanical extracts can be performed. It also offers a platform with which to study the impacts of the treatment on the metabolic parameters both in the short and long-term. The low cost, ease of repetition and test protocols will make it ideal as a preclinical touch point to screen natural products such as *Ipomoea quamoclit L.,* thus scientifically proving the traditional evidence.

Importance of Measuring Fasting Blood Glucose Over Time

Presence of fasting blood glucose (FBG) is a significant determinant of diabetes measuring and diagnosis. Measurements made on repeated occasions provide insight in terms of the effectiveness and sustainability of a therapeutic intervention. An overall reduction in FBG in the after treatment period indicates a positive effect in glycemic control based on the finding that insulin sensitivity or secretion may also improve(30). In the experiment, blood level of glucose was analyzed on the 1st, 10th, 20th, and 30th days to assess the cumulative effect of extract of *Ipomoea quamoclit L.*. It is needed to mention that transient effects may be distinguished with the help of this time-course analysis, and this is the key to understanding the effectiveness of herbal treatments in diabetes management as well.

Role of Lipid Profile (TG, TC, HDL, LDL, VLDL) in Assessing Diabetes Progression and Control

In assessing diabetic dyslipidemia, lipid profile which consists of LDL, HD, VLDL, TC, triglycerides (TG), and LDL is critical to examine. Inadequate glycemic control commonly leads to high levels of TG and LDL, and low levels of HDL, subsequently leading to the possibility of cardiovascular complications. By keeping such parameters, the effectiveness of the treatment can be determined not only in regard to regulating the blood sugar, but also to regulating the metabolism of lipids. Modifications of lipid profile after the therapy reflect an arrest of metabolism and decrease in the atherogenesis risk. Hence, it is important to evaluate lipids parameters in order to have a complete picture of the effect of any treatment in diabetes-like conditions(31).

Body Weight as an Additional Indicator of Metabolic Improvement

An essential physiologic indicator that denotes the general metabolism in diabetic animals is body weight. STZ-induced diabetes is normally accompanied by weight loss as the degradation of muscle proteins is high, and there is an inability to utilize glucose. Reversal or maintenance of decreased weight after treatment is an indicator of good nutrition absorption, energy expenditure and blood sugar balance. Observation of body weight, glucose and lipid profile provide the entire picture of the therapeutic potential of a test molecule. The weight prevention capacity of *Ipomoea quamoclit L.* extract in this research is a discriminatory discovery in favor of the positive impact that the extract will have on the metabolic health of diabetic rats(32, 33).

The present study was designed to evaluate the antidiabetic and antidyslipidemic potential of the hydroalcoholic extract of *Ipomoea quamoclit L.* whole plant in streptozotocin (STZ)-induced diabetic Wistar rats. The study aimed to assess its effect on fasting blood glucose levels, lipid profile parameters (TG, TC, HDL, LDL, VLDL), and body weight over a 30-day treatment period.

Materials & Methods

Collection of Plant Material

For the current investigation, the whole plant of *Ipomoea quamoclit L.* was collected from the forest region surrounding Madanapalle, located in the Chittoor district of Andhra Pradesh, India. The plant material was taxonomically identified and authenticated by Dr. K. Madhava Chetty, Assistant Professor, Department of Botany, Sri Venkateswara University, Tirupati, Andhra Pradesh. A voucher specimen (RIPER/ASK/002) has been deposited in the Pharmacognosy division of Raghavendra Institute of Pharmaceutical Education and Research (RIPER), Anantapuramu, for future reference and verification.

Extraction

In this study, 1000 grams of the powdered whole plant of *Ipomoea quamoclit L.* was subjected to extraction using the cold maceration technique. A hydroalcoholic solvent system consisting of ethanol and water in a 3:2 ratio was used. The maceration process was carried out for 72 hours with intermittent stirring to facilitate efficient extraction. After the extraction period, the mixture was filtered, and the filtrate was concentrated using a rotary evaporator. This procedure yielded a greenish, resinous extract, which was weighed to determine the percentage yield. The extract was labeled as HAIQ (Hydroalcoholic extract of *Ipomoea quamoclit L.*) and stored in a desiccator until further use(24).

Phytochemical Screening

The hydroalcoholic extract obtained from the whole plant of *Ipomoea quamoclit L.* was analysed for the presence of various phytoconstituents using standard preliminary phytochemical screening methods. These qualitative tests were carried out to detect major classes of secondary metabolites such as alkaloids, flavonoids, saponins, tannins, glycosides, phenols, terpenoids, and steroids. The procedures followed were in accordance with established protocols documented in phytochemical analysis literature. This preliminary screening served to identify the key bioactive compounds that may contribute to the plant's observed pharmacological effects and provided a scientific foundation for its further biological evaluation(24).

Animals

In the current experiment, the adult swiss albino mouse (weighing 20 to 30 g) was used to test acute toxicity and wistar albino rat (weighing between 150 and 200 g and aged approximately 6-8 weeks of either sex) was chosen as a pharmacological model. Both Swiss albino mice (for acute toxicity) and wistar albino rats (for antidiabetic study) were maintained under identical laboratory conditions at room temperature of 25±2°C, humidity of 55% and with a light-dark cycle of 12 h. Standard pellet diet and water ad lib were available to them freely. Nevertheless, before every experiment, the withdrawal of food 12 hours before was done to eliminate effects on the absorption of test things. Animal treatments and laboratory procedures conformed to the ethical guidelines set by the Committee of the Purpose of Control and Supervision of Experiments on animals (CPCSEA), New Delhi. The Institutional Animal Ethics Committee (IAEC) of Raghavendra Institute of Pharmaceutical Education and Research (RIPER), Anantapuramu, Andhra Pradesh, India had previously given approval on the study protocol.

Gross behavioural and toxicity studies

The hydroalcoholic extract derived from the whole plant of *Ipomoea quamoclit L.* (HAIQ) was subjected to acute toxicity and gross behavioral assessment in Swiss albino mice. Groups consisting of six mice each were administered escalating oral doses of the extract—specifically 100, 200, 400, 800, 1000, 2000, and 3000 mg/kg body weight—formulated in 0.5% w/v sodium carboxymethyl cellulose as the suspending agent. Dosing was performed orally using a gastric feeding tube. Following administration, animals were closely monitored for the initial four hours for any immediate behavioral or physiological abnormalities, and further observed for mortality or delayed toxic effects over a 72-hour period. No signs of toxicity or deaths were recorded at any of the tested doses, indicating a favorable safety profile of the extract. Based on the outcomes of this acute toxicity study, two doses—250 mg/kg and 500 mg/kg body weight—were selected for evaluating the antidiabetic efficacy of HAIQ in streptozotocin-induced diabetic rat models.

Induction of diabetes

To induce experimental diabetes, Wistar albino rats were administered a single intraperitoneal injection of streptozotocin (STZ) at a dose of 55 mg/kg body weight. STZ was freshly prepared in an ice-cold 0.1 M citrate buffer with a pH of 4.5 to ensure stability and maximum effectiveness of the compound. This diabetogenic agent selectively targets pancreatic β-cells, causing cellular damage through alkylation of DNA and the generation of reactive oxygen species, ultimately leading to insulin deficiency and persistent hyperglycemia. After 48 hours of STZ administration, blood samples were collected from the tail vein, and fasting blood glucose levels were measured using a standard glucometer. Only animals exhibiting hyperglycemia, defined as fasting blood glucose levels above 180 mg/dL, were considered successfully diabetic and included in the subsequent experimental protocols. This threshold ensured the exclusion of borderline or non-responsive animals and maintained experimental reliability. The model replicates key metabolic disturbances seen in human Type 1 and early Type 2 diabetes, making it a well-established and reproducible system for evaluating the efficacy of potential antidiabetic agents, including herbal extracts like the hydroalcoholic extract of *Ipomoea quamoclit L. L.* .

Experimental design

Studies on Streptozotocin-induced diabetic rats

For the evaluation of antidiabetic activity, the selected Wistar albino rats were randomly assigned into six experimental groups, each consisting of six animals (n = 6). The treatment schedule was maintained for a period of 30 consecutive days, with all administrations given via the oral route using an appropriate vehicle.

- **Group I (Normal Control):** Non-diabetic rats received 1% w/v sodium carboxymethyl cellulose (CMC) orally throughout the study duration to serve as the baseline group.
- **Group II (Diabetic Control):** Diabetic rats were administered only the vehicle (1% w/v CMC orally) for 30 days, without any therapeutic intervention, to observe the progression of untreated diabetes.
- **Group III (Standard Treatment):** Diabetic animals in this group received Glibenclamide at a dose of 10 mg/kg body weight, dissolved in distilled water. This group served as the positive control to compare the efficacy of the plant extract.
- **Group IV (Test Group I):** Diabetic rats were treated with the hydroalcoholic extract of *Ipomoea quamoclit L. L.* (HAIQ) at a dose of 250 mg/kg body weight, suspended in 1% w/v CMC and administered orally.
- **Group V (Test Group II):** Diabetic rats received a higher dose of HAIQ, specifically 500 mg/kg body weight, following the same route and vehicle as in Group IV.

All animals were observed daily for general health, behaviour, and any adverse effects throughout the study. This grouping design allowed for a comparative evaluation of the dose-dependent antidiabetic potential of HAIQ relative to both untreated and standard-treated diabetic controls.

Collection of blood samples

During the course of the experiment, blood samples (approximately 1.5 mL) were collected from each rat on the 1st, 10th, 20th, and 30th day to monitor fasting blood glucose levels. Blood collection was performed via the retro-orbital plexus, a commonly used technique in rodents, under light anesthesia to minimize stress and discomfort to the animals. After collection, the blood samples were allowed to stand undisturbed to facilitate clot formation, following which they were subjected to centrifugation at 3000 revolutions per minute (rpm) for 15 minutes to separate the serum. The obtained serum was carefully collected and stored under appropriate conditions until analysis. Blood glucose levels were measured using a commercially available glucometer (OneTouch Ultra, Johnson & Johnson Ltd.), which offers rapid and reliable estimations. This periodic monitoring allowed for the evaluation of glycemic trends over time and facilitated the assessment of the therapeutic efficacy of the test extract across different treatment groups.

Biochemical estimations and body weight

On the 30th day of the experimental study, following the final blood glucose assessment, serum lipid profiles were analyzed to evaluate the metabolic alterations associated with streptozotocin (STZ)-induced diabetes and the effect of the test treatments. After collecting blood via the retro-orbital plexus, the serum was separated through centrifugation and used for lipid analysis. The following parameters were estimated using standard biochemical methods:

- **Total Cholesterol (TC):** Quantified using the CHOD/PAP (cholesterol oxidase-peroxidase) enzymatic method,
- **Triglycerides (TG):** Measured using the GPO/PAP (glycerol phosphate oxidase–peroxidase) method,
- **High-Density Lipoprotein (HDL-C):** Determined via the PEG precipitation method, which facilitates selective separation of HDL,
- **Low-Density Lipoprotein (LDL-C) and Very Low-Density Lipoprotein (VLDL-C):** These values were either directly estimated or calculated using standard formulas based on total cholesterol, HDL, and triglyceride levels.

Additionally, body weights of all animals were recorded on day 1 (baseline) and again on day 30, using a digital animal balance to monitor any significant changes. Alterations in lipid parameters and body weight provided valuable insights into the metabolic improvements following treatment and the overall efficacy of the hydroalcoholic extract of *Ipomoea quamoclit L.* in regulating diabetic dyslipidemia.

Statistical significance

All experimental data were presented as mean ± standard error of the mean (SEM) for each group. To determine the statistical relevance of the observed differences among various treatment groups, the data were subjected to one-way analysis of variance (ANOVA). This method helped assess whether there were significant variations between the control, diabetic, and treatment groups. Following ANOVA, Bonferroni's post hoc test was employed for multiple comparisons to identify specific group differences with greater precision. All statistical analyses were conducted using GraphPad Prism software, version 4.5 (GraphPad Software Inc., USA), which is widely utilized for biomedical research due to its robust analytical tools and graphical interface. A p-value of less than 0.05 ($p < 0.05$) was considered indicative of statistical significance, while values of $p < 0.01$ and $p < 0.001$ were interpreted as highly significant and very highly significant, respectively. This rigorous statistical approach ensured the reliability and reproducibility of the findings derived from the antidiabetic and biochemical evaluations.

Results

Extraction

The hydroalcoholic extraction of *Ipomoea quamoclit L.* whole plant using cold maceration with an ethanol:water (3:2) solvent system yielded 36.4 grams of a thick green viscous extract from 1000 grams of dried plant material, corresponding to an extraction yield of 3.64% w/w. This is a moderate and acceptable yield for crude extracts and reflects an efficient recovery of soluble bioactive constituents under mild conditions, helping preserve thermolabile phytochemicals. Extraction yield serves as a foundational step in standardizing herbal formulations and is influenced by several factors, including solvent polarity, plant matrix, extraction duration, temperature, and agitation. The ethanol-water mixture likely facilitated the dissolution of a broad range of constituents, particularly polar and mid-polar compounds such as flavonoids, phenolics, alkaloids, saponins, and glycosides many of which are documented in *Ipomoea quamoclit L.* . The nature of the extract green and resinous suggests the presence of chlorophyll and polyphenolic compounds, known for their antioxidant and therapeutic properties. A yield of 3.64% indicates a sufficient concentration of extractable pharmacologically active matter to justify its traditional use in managing diseases such as diabetes and inflammation(34-36).

Preliminary phytochemical analysis

The preliminary phytochemical screening of the hydroalcoholic extract of *Ipomoea quamoclit L.* whole plant revealed a wide array of secondary metabolites, including alkaloids, carbohydrates, saponins, phytosterols, phenolic compounds, tannins, flavonoids, proteins, amino acids, terpenoids, gums, and mucilages. This diverse phytochemical composition underscores the plant's pharmacological potential and supports its traditional therapeutic use. Alkaloids may contribute to antidiabetic effects through insulin modulation. Saponins and phytosterols are known for their hypoglycemic and lipid-lowering actions, while carbohydrates and proteins offer metabolic support. Phenolic compounds and flavonoids, with their strong antioxidant and anti-inflammatory properties, can protect against oxidative stress a key factor in diabetes progression. Tannins and terpenoids add further antimicrobial, anti-inflammatory, and healing properties, while amino acids and mucilages may aid in tissue repair and gastrointestinal protection. The collective presence of these compounds suggests a synergistic mechanism behind the observed antidiabetic and antihyperlipidemic effects(24, 37). These findings justify the traditional use of *Ipomoea quamoclit L.* in managing diabetes and highlight the need for further phytochemical and pharmacological investigations to isolate active constituents and elucidate their mechanisms of action.

Antidiabetic activity

Effect on blood glucose levels

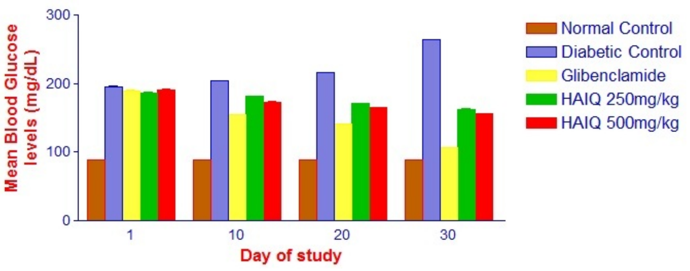
Streptozotocin (STZ) is a well-established agent used to induce experimental diabetes in rodents through its selective cytotoxicity to pancreatic β-cells, leading to hypoinsulinemia and consequent hyperglycemia. In the present study, STZ administration resulted in a significant elevation in blood glucose levels in rats, validating the diabetic model, with diabetic control animals showing a progressive increase in blood glucose from 195.24 ± 0.29 mg/dL on Day 1 to 239.5 ± 0.16 mg/dL by Day 30, indicating sustained hyperglycemia. In contrast, treatment with the hydroalcoholic extract of *Ipomoea quamoclit L.* (HAIQ) at both 250 mg/kg and 500 mg/kg demonstrated a significant and dose-dependent reduction in blood glucose levels over the 30-day period. At 250 mg/kg, blood glucose levels declined from 185.97 ± 1.03 mg/dL on Day 1 to 162.20 ± 1.28 mg/dL on Day 30, showing statistically significant reductions starting from Day 10 ($p<0.01$) and further improvements by Day 30 ($p<0.001$), while at 500 mg/kg, glucose levels decreased from 191.47 ± 0.66 mg/dL to 155.58 ± 0.81 mg/dL ($p<0.001$ from Day 20 onwards). These effects were comparable to the standard reference drug Glibenclamide (10 mg/kg), which reduced glucose from 189.7 ± 0.39 mg/dL to 130.1 ± 0.24 mg/dL by Day 30 **as shown in Table 1**. The observed antidiabetic activity of *Ipomoea quamoclit L.* may be attributed to its phytochemical constituents including flavonoids, alkaloids, saponins, and phenolic compounds, which are known to exert antihyperglycemic effects through mechanisms such as enhancing insulin secretion from remnant β-cells, improving insulin sensitivity, promoting peripheral glucose uptake, and inhibiting intestinal glucose absorption **as shown in Figure 1**.

Table 1: Effect of *Ipomoea quamoclit L.* whole plant on blood glucose levels of STZ induced diabetic rats

Group	Mean Blood glucose conc. (mg/dl.)			
	1st Day	10th Day	20th Day	30st Day
Normal control	89.16± 0.08	88.48± 0.22	89.1± 0.11	88.4± 0.12
Diabetic control	195.24± 0.29	203.5± 0.15	216.5± 0.08	239.5± 0.16
Glibenclamide 10mg/kg	189.7± 0.39^{a}	154.2± 0.23^{b}	141.3± 0.14^{b}	130.1± 0.24^{c}
HAIQ 250 mg/kg	185.97± 1.03^{a}	181.07± 0.34^{b}	170.70± 0.32^{b}	162.20± 1.28^{c}
HAIQ 500 mg/kg	191.47± 0.66^{b}	173.47± 0.20^{b}	165.46± 0.46^{c}	155.58± 0.81^{c}

All values were expresses as Mean±SEM, one way ANOVA followed by Bonferroni's test, a: $p<0.05$, b: $p<0.01$ and c: $p<0.001$ when compared to diabetic control group; HAIQ-Hydroalcoholic extract of *Ipomoea quamoclit L.* whole plant

Figure 1: Effect of *Ipomoea quamoclit L.* whole plant on blood glucose levels of STZ induced diabetic rats



The plant extract's gradual and sustained effect over 30 days suggests a modulatory role rather than an acute hypoglycemic action, which may be beneficial for long-term glycemic control in diabetic patients. These findings support the ethnopharmacological use of *Ipomoea quamoclit L.* in traditional medicine for diabetes management; however, further mechanistic studies and compound isolation are warranted to identify the exact bioactive agents responsible for its antidiabetic effects.

Effect on lipid profile

Diabetes mellitus is often accompanied by dyslipidemia, characterized by elevated serum triglycerides (TG), total cholesterol (TC), low-density lipoprotein (LDL), very-low-density lipoprotein (VLDL), and reduced high-density lipoprotein (HDL). This abnormal lipid profile increases the risk of cardiovascular complications, making lipid control an essential target in diabetes management. In the present study, STZ-induced diabetic rats exhibited significant dyslipidemia by Day 30, with marked increases in triglycerides (157.32 ± 1.38 mg/dL), total cholesterol (143.16 ± 0.39 mg/dL), LDL (93.70 ± 0.27 mg/dL), and VLDL (43.58 ± 0.19 mg/dL), along with a decrease in HDL levels (14.37 ± 0.12 mg/dL) when compared to normal controls.

Administration of the hydroalcoholic extract of *Ipomoea quamoclit L.* (HAIQ) at both 250 mg/kg and 500 mg/kg doses significantly improved the lipid profile in diabetic rats. At 250 mg/kg, there was a notable reduction in triglycerides (63.44 ± 0.23 mg/dL; $p<0.05$), LDL (42.02 ± 0.54 mg/dL; $p<0.01$), and VLDL (14.33 ± 0.22 mg/dL; $p<0.05$), along with a significant increase in HDL (25.20 ± 0.12 mg/dL; $p<0.05$). Total cholesterol also improved (84.44 ± 0.24 mg/dL), though not statistically significant at this dose. At the higher dose of 500 mg/kg, the extract demonstrated even greater efficacy, significantly reducing total cholesterol (72.15 ± 0.31 mg/dL; $p<0.05$), increasing HDL (30.82 ± 0.12 mg/dL; $p<0.01$), and normalizing VLDL (14.58 ± 0.17 mg/dL; $p<0.001$) **as shown in Table 2**. These changes were comparable to those observed with Glibenclamide treatment, which served as the standard control and also normalized lipid levels effectively **as shown in Figure 2**.

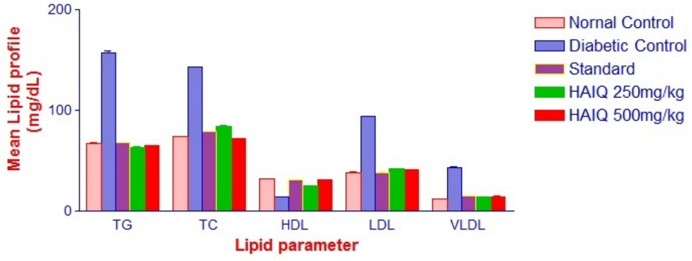
Table 2: Effect of *Ipomoea quamoclit L.* whole plant on lipid profile of STZ induced diabetic rats

Group	Mean Lipid profile (mg/dL)				
	Triglycerides	Total cholesterol	HDL	LDL	VLDL
Normal control	67.58± 0.49	74.25± 0.32	32.08± 0.18	38.50± 0.20	12.21± 0.11
Diabetic control	157.32± 1.38	143.16± 0.39	14.37± 0.12	93.70± 0.27	43.58± 0.19
Glibenclamide 10mg/kg	68.00 ± 0.06^{a}	78.96± 0.32^{a}	31.16± 0.13^{b}	38.62± 0.23^{b}	14.98± 0.12^{c}
HAIQ 250 mg/kg	63.44± 0.23^{a}	84.44± 0.24	25.20± 0.12^{a}	42.02± 0.54^{b}	14.33± 0.22^{a}
HAIQ 500 mg/kg	65.40± 0.24	72.15± 0.31^{a}	30.82± 0.12^{b}	41.23± 0.30	14.58± 0.17^{c}

All values were expresses as Mean± SEM, one way ANOVA followed by Bonferroni's test, a: $p<0.05$, b: $p<0.01$ and c: $p<0.001$ when compared to diabetic control group; HAIQ-Hydroalcoholic extract of *Ipomoea quamoclit L.* whole plant.

The beneficial effects of *Ipomoea quamoclit L.* on lipid metabolism can be attributed to the presence of bioactive phytoconstituents such as flavonoids, saponins, sterols, and alkaloids. These compounds are known to exert lipid-lowering effects through multiple mechanisms, including inhibition of cholesterol synthesis, enhancement of lipid metabolism, modulation of LDL receptor expression, and increased bile acid excretion. Furthermore, the antioxidant properties of phenolic compounds and flavonoids may reduce oxidative stress and lipid peroxidation, which play key roles in the pathogenesis of diabetic dyslipidemia.

Figure 2: Effect of *Ipomoea quamoclit L.* whole plant on lipid profile of STZ induced diabetic rats



Body weight

Body weight is a vital physiological parameter in assessing the general health and metabolic status of animals, especially in diabetes research. Weight loss is a hallmark symptom of diabetes mellitus and is commonly observed in STZ-induced diabetic animal models due to increased muscle wasting, protein catabolism, and reduced glucose utilization, all consequences of insulin deficiency or resistance. In the present study, STZ administration in rats resulted in a marked decrease in body weight over the 30-day experimental period. Diabetic control animals showed a significant reduction in weight from 167.5 ± 0.42 g on Day 1 to 106.85 ± 0.62 g on Day 30, highlighting the catabolic state induced by persistent hyperglycemia as shown in Figure 3.

Treatment with the hydroalcoholic extract of *Ipomoea quamoclit L.* (HAIQ) was effective in mitigating this weight loss. Rats treated with 250 mg/kg of the extract maintained relatively stable body weights, with only a slight change from 174.37 ± 0.30 g to 178.76 ± 0.82 g over 30 days, indicating a protective effect against weight reduction, though the improvement was not statistically significant. In contrast, the higher dose of 500 mg/kg demonstrated a more pronounced effect, significantly improving body weight from 176.71 ± 0.34 g to 180.92 ± 0.22 g ($p<0.01$). This result was comparable to the standard drug Glibenclamide (10 mg/kg), which also prevented weight loss and significantly increased body weight ($p<0.01$) as shown in Table 3.

The improvement in body weight in extract-treated groups may be attributed to better glycemic control, as demonstrated in the blood glucose data, which would have reduced protein breakdown and enhanced carbohydrate utilization. Additionally, the phytochemical constituents of *Ipomoea quamoclit L.* , such as flavonoids, alkaloids, and sterols, may play a role in improving insulin action and metabolic efficiency, contributing to better nutrient assimilation and energy balance in diabetic animals.

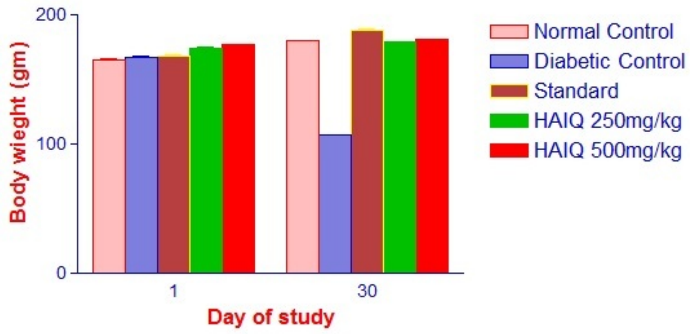
The weight-preserving effect suggests that *Ipomoea quamoclit L.* may also possess anabolic or anti-catabolic properties that counteract the severe muscle and fat tissue depletion associated with diabetes. This anabolic preservation is essential not only for overall health but also for preventing secondary complications linked with chronic diabetic wasting.

Table 3: Effect of *Ipomoea quamoclit L.* whole plant on body weight of STZ induced diabetic rats

Group	Mean Body weight (gm)	
	1st day	30th day
Normal control	165.39±0.39	179.79±0.76
Diabetic control	167.5±0.42	106.85±0.62
Glibenclamide 10mg/kg	168.66±0.62^{a}	188.34±0.38^{a}
HAIQ 250 mg/kg	174.37±0.30	178.76±0.82
HAIQ 500 mg/kg	176.71±0.34^{a}	180.92±0.22^{a}

All values were expresses as Mean± SEM, one way ANOVA followed by Bonferroni's test, a: $p<0.01$ when compared to diabetic control group; HAIQ- Hydroalcoholic extract of *Ipomoea quamoclit L.* whole plant

Figure 3: Effect of *Ipomoea quamoclit L.* whole plant on body weight of STZ induced diabetic rats



Discussion

The present investigation evaluated the antidiabetic and antidyslipidaemic effects of the hydroalcoholic extract of *Ipomoea quamoclit L.* in streptozotocin (STZ)-induced diabetic rats. STZ selectively destroys pancreatic β-cells through DNA alkylation and oxidative stress, resulting in insulin deficiency and persistent hyperglycaemia. The significant elevation in fasting blood glucose observed in diabetic control animals confirms successful induction of experimental diabetes.

Oral administration of HAIQ produced a dose-dependent reduction in fasting blood glucose levels over the 30-day treatment period. The gradual yet sustained antihyperglycaemic effect suggests that the extract may not act as an acute hypoglycaemic agent but rather improves glycaemic regulation over time. This pattern is often associated with mechanisms such as enhanced peripheral glucose uptake, improved insulin sensitivity, regeneration or protection of residual β-cells, and inhibition of hepatic gluconeogenesis. Similar glucose-lowering effects have been reported in flavonoid- and phenolic-rich plant extracts, which exert protective effects against oxidative stress-mediated pancreatic damage.

Phytochemical screening revealed the presence of flavonoids, alkaloids, saponins, phenolics, and phytosterols in the extract. Flavonoids are known to enhance insulin secretion, improve insulin receptor signalling, and inhibit carbohydrate-digesting enzymes. Saponins and alkaloids have been reported to modulate glucose transport and reduce intestinal glucose absorption. Therefore, the observed antihyperglycaemic activity of *Ipomoea quamoclit L* may result from synergistic interactions among these bioactive compounds.

Dyslipidaemia is a common metabolic abnormality associated with diabetes and significantly contributes to cardiovascular risk. In the present study, STZ-induced diabetic rats exhibited elevated triglycerides, total cholesterol, LDL, and VLDL levels along with reduced HDL levels. These alterations are primarily due to enhanced lipolysis, increased free fatty acid flux to the liver, and impaired lipid metabolism secondary to insulin deficiency.

Treatment with HAIQ significantly improved lipid parameters in a dose-dependent manner. The reduction in triglycerides and LDL levels, along with elevation of HDL, indicates restoration of lipid homeostasis. These effects may be attributed to inhibition of hepatic cholesterol biosynthesis, enhanced LDL receptor activity, increased bile acid excretion, and improved insulin-mediated regulation of lipid metabolism. The antioxidant properties of phenolic compounds present in the extract may also reduce lipid peroxidation, thereby preventing oxidative modification of lipoproteins, a key factor in atherogenesis.

Body weight loss observed in diabetic control animals reflects increased protein catabolism and impaired glucose utilization. The prevention of weight loss in extract-treated groups suggests improved metabolic efficiency and better glycaemic control. Maintenance of body weight may indicate restoration of anabolic processes and reduced muscle wasting, further supporting the therapeutic potential of the extract.

The higher dose (500 mg/kg) consistently demonstrated greater efficacy across all parameters, suggesting a dose-dependent pharmacological response. The effects were comparable to glibenclamide, indicating that *Ipomoea quamoclit L* possesses clinically relevant antihyperglycaemic and lipid-lowering potential.

The findings validate the traditional use of *Ipomoea quamoclit L* in metabolic disorders and suggest its potential as a promising candidate for further phytopharmacological development.

Conclusion

The present study was undertaken to evaluate the antidiabetic and antidyslipidaemic potential of the hydroalcoholic extract of *Ipomoea quamoclit L*. in STZ-induced diabetic rats. The findings clearly demonstrate that the extract significantly reduces fasting blood glucose levels, improves serum lipid profile parameters, and prevents diabetes-associated body weight loss in a dose-dependent manner.

The higher dose (500 mg/kg) exhibited greater therapeutic efficacy and showed results comparable to the standard drug glibenclamide. These effects may be attributed to the presence of bioactive phytoconstituents such as flavonoids, alkaloids, saponins, and phenolic compounds, which are known to modulate glucose and lipid metabolism.

Thus, the study scientifically substantiates the traditional medicinal use of *Ipomoea quamoclit L*. in the management of diabetes and associated dyslipidaemia. Further investigations focusing on molecular mechanisms, isolation of active compounds, histopathological evaluation, and clinical validation are warranted to establish its potential as a safe and effective phytotherapeutic agent.

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Conflict of Interest

The authors do not have any conflict of interest.

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