EXTRACTION AND EVALUATION OF ANTIDIABETIC ACTIVITY OF POLYHERBAL EXTRACT AGAINST STREPTOZOTOCIN INDUCED DIABETIC RATS

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ABSTRACT

The purpose of this study was to assess the biochemical, physiological, and anti-diabetic effects of extracts from the seeds of Syzygium cumini and Ziziphus vulgaris in rats with diabetes induced by streptozotocin (STZ). Group 1 (Control), Group 2 (Negative Control: STZ + Vehicle), Group 3 (Standard Treatment Control: STZ + Glibenclamide 5 mg/kg), Group 4 (Low Dose PHPE: 200 mg/kg), and Group 5 (High Dose PHPE: 400 mg/kg) were the five randomly assigned groups of 30 STZ-induced diabetic rats. Every week, blood samples were taken to measure fasting blood glucose. Serum glucose, ALT, AST, total protein, cholesterol, creatinine, and urea levels were among the biochemical markers that were examined. When compared to the negative control, treatment with extracts from Ziziphus vulgaris and Syzygium cumini dramatically reduced the fasting blood glucose levels in diabetic rats. Improved liver function markers, such as lower ALT and AST levels, were found by biochemical studies, especially in groups who received a high dosage of polyherbal extract (PHPE). Different groups displayed different levels of kidney function markers, with the therapy groups exhibiting notable increases in creatinine and urea levels. The results of this study imply that extracts from Ziziphus vulgaris and Syzygium cumini have anti-diabetic qualities and may lessen physiological and biochemical abnormalities in rats with STZ-induced diabetes. These findings provide credence to the potential therapeutic use of these plant extracts in the treatment of diabetes and associated complications, calling for more research into their modes of action and long-term impacts.

Keywords: Diabetes, Streptozotocin (STZ), Syzygium cumini, Ziziphus vulgaris.

INTRODUCTION

A chronic metabolic disease called diabetes mellitus is typified by persistently high blood sugar levels brought on by either decreased insulin action or secretion, or both. With serious consequences such neuropathy, nephropathy, retinopathy, cardiovascular disorders, and poor wound healing, it has emerged as a global health concern.[1] Of the various forms of diabetes, insulin resistance is the main cause of Type 2 diabetes, whereas autoimmune destruction of pancreatic β-cells causes Type 1 diabetes.[2].

Insulin injections and oral hypoglycemic medications, which assist control blood glucose levels, are commonly used in conventional diabetic therapy. However, a number of adverse effects, including as hypoglycemia, gastrointestinal issues, and long-term difficulties, are frequently associated with these treatments. In order to properly manage diabetes, there is a growing interest in alternative medicines, particularly those that come from natural sources.[3] The use of herbal therapies and polyherbal formulations has become more popular in recent years as people look for safer and more efficient ways to treat diabetes. Plants that are abundant in bioactive substances such terpenoids, alkaloids, phenolic acids, and flavonoids have demonstrated encouraging qualities that prevent diabetes. Compared to single-drug therapy, polyherbal formulations, which blend many plant extracts, have a synergistic effect that can increase therapeutic efficacy and decrease side effects. [4,5].

A popular animal paradigm for examining the pathogenesis of diabetes and assessing the possible antidiabetic benefits of natural substances is streptozotocin (STZ)-induced diabetes in rats.[6] STZ is a valid way to evaluate hypoglycemic medications since it specifically kills pancreatic β-cells, simulating the effects of Type 1 diabetes in people.[7]

In this work, STZ-induced diabetic rats will be used to assess the antidiabetic effects of a polyherbal extract. It is believed that the polyherbal formulation, which consists of various medicinal plants with well-known antidiabetic qualities, may reduce blood glucose, enhance insulin sensitivity, and lessen oxidative stress in diabetic patients.[8] The results of this investigation may shed important light on the viability of polyherbal medicines as substitute diabetes treatments.[9] Zhao et al. (2013) found that Ziziphus vulgaris seeds, rich in flavonoids and saponins, significantly reduced blood glucose levels and enhanced insulin sensitivity in streptozotocin (STZ)-induced diabetic rats.[10] Sharma et al. (2003) demonstrated that Syzygium cumini seeds exhibited strong antidiabetic properties, particularly due to their active compounds like jamboline, which improved insulin secretion and pancreatic function, resulting in lower blood glucose levels.[11] Aqil et al. (2006) reported that Syzygium cumini seeds not only regulated blood glucose but also exhibited antioxidant properties, which helped reduce oxidative stress in diabetic rats, aiding overall glycemic control.[12] Modak et al. (2007) highlighted the efficacy of polyherbal formulations, showing that combining multiple medicinal plants yields a synergistic effect in managing diabetes by targeting various pathways like insulin sensitivity, glucose uptake, and antioxidant activity.[13] Singh et al. (2011) studied the effect of a polyherbal formulation containing Ziziphus vulgaris and Syzygium cumini, noting that the combination significantly reduced hyperglycemia and improved lipid profiles

in diabetic models.[14] Grover et al. (2002) reviewed various Indian medicinal plants with antidiabetic potential, concluding that polyherbal treatments, including Ziziphus vulgaris and Syzygium cumini, offer promising hypoglycemic effects due to their combined bioactive compounds that improve glucose metabolism.[15]

A promising method for managing diabetes is the use of Syzygium cumini and Ziziphus vulgaris seeds together in polyherbal preparations. The combined benefits of their Bioactive substances can lower the risk of diabetic complications by improving blood glucose management and offering defence against oxidative stress. Rats with diabetes caused by STZ will be used in this investigation to assess the antidiabetic properties of these polyherbal extracts.

Materials and Procedures

Content Utilised

Ziziphus vulgaris and Syzygium cumini seeds from the botanical garden were among the study's resources. While streptozotocin was bought from a local store, Dragendorff's reagent was obtained from the college lab. The college lab also provided various chemicals and distilled water. Numerous test kits, such as those for creatinine, AST, and cholesterol, protein, glucose oxidase, and cholesterol colorimetric assay kits, were supplied by Span Diagnostics Limited, India. Ethanol and methanol were procured from Sigma Aldrich, India. All other chemicals utilized in the study were of analytical grade.

Tool Employed

The study's instruments comprise a number of crucial pieces of equipment that were mostly obtained from the college lab. These include of test tubes, beakers, a digital weighing balance, a vortex shaker, a BOD incubator, a glucometer, a muffled furnace, a vacuum evaporator, a hot plate and a pH meter. Additionally, a cold centrifuge machine (Model No.: C-24 BL) and a micro-centrifuge (also Model No.: C-24 BL) were provided by Remi, and an electric homogeniser (Model No.: 607) was purchased from Ever Shine.

Collection and Authentication of Crude Drugs

A nearby Kadipur nursery in Sultanpur provided the raw materials for the polyherbal blend, which included seed extracts from Ziziphus vulgaris and *Syzygium cumini*. On April 4, 2024, a botanist used reference letter No. SIP/2024/101-G from the Botanical Survey of India to confirm the seeds. A local chemist provided streptozotocin. The calibrated instruments were provided by the college in accordance with standard operating procedures, and all of the reagents used were of analytical quality.

Preparation of Plant extracts from plants

A botanist gathered and verified fresh seeds of Ziziphus vulgaris and *Syzygium cumini.* The seeds were cleaned with distilled water, allowed to air dry for seven to ten days, and then milled into a fine powder. About 100 grammes of the ground seeds were put in a thimble with 500 millilitres of ethanol in a Soxhlet extractor to be extracted. In order to extract the plant ingredients, the ethanol was heated by the heating mantle and allowed to evaporate and condense in the thimble after being connected to a condenser. The solvent in the syphon tube turned colourless after 6–8 hours of this operation. The thimble was taken out once it had cooled, and Whatman No. 1 filter paper was used to filter the extract. It was concentrated using a rotary evaporator, transferred to a petri dish, and dried at room temperature or in avacuum oven at 40°C. The dried extract was then weighed and stored in an airtight container in a refrigerator at 4°C for future use.

Evaluation of Organoleptic evaluation

To guarantee quality and acceptability, organoleptic evaluation evaluates the extracts of *Syzygium cumini* and *Ziziphus vulgaris* based on their appearance, colour, odour, taste, and texture. A tiny, precisely calculated amount of each extract is first put on sterile glass plates or petri dishes and allowed to come to room temperature. Each member of the panel of skilled assessors who are knowledgeable with sensory methods is given a sensory evaluation form to use when documenting their observations. The extracts are evaluated according to a number of criteria, including appearance, which notes the physical shape; colour, which ranges from bright green to dark brown; odour, which describes the aroma; taste, which determines whether the sample is safe to consume; and texture, which evaluates consistency for semi-solid forms.

Physicochemical parameters

Air dried powder plant materials were subjected for following physicochemical parameters.

Moisture content/Loss on drying:

Determining the moisture content, or loss on drying (LOD), is crucial for evaluating the quality and stability of plant extracts, as it influences shelf life and efficacy. To perform this assessment, first, clean and dry a weighing dish or crucible, then place it in an oven at 105°C for 1 hour to eliminate moisture. After cooling the dish in a desiccator, weigh it using an analytical balance and record the weight as W1. Accurately weigh 2-5 grams of the Syzygium cumini and Ziziphus vulgaris seed extract, transferring it to the pre-weighed dish, and record the combined weight as W2. Place the dish in the oven at 105°C for 3-4 hours or until achieving a constant weight, ensuring the sample is spread evenly for uniform drying. After drying, cool the dish in the desiccator and weigh it again, recording the final weight as W3. Calculate the moisture content (loss on drying) using the following formula:

$$\textbf{Moisture Content(\%)} = [(W2 - W3)/(W2 - W1)] \times 100$$

Determination of ash

Total ash

A common technique for figuring out the mineral content of plant material is to measure the total ash content, which aids in evaluating the extract's quality, purity, and possible adulteration. A crucible is first allowed to cool in a desiccator before being weighed using an analytical balance and its weight recorded as W1 in order to conduct this test. Weigh two to three grammes of the seed extract from Syzygium cumini and Ziziphus vulgaris precisely, then transfer it to the crucible that has already been weighed. Write the combined weight as Z. After placing the crucible in a muffle furnace, raise the temperature gradually to 550°C and keep it there for four to six hours, or until a white or light grey ash forms. After ashing, turn off the furnace and allow it to cool safely before removing the crucible with tongs, then transfer it to a desiccator to cool to room temperature. Finally, weigh the crucible with the ash using an analytical balance and record the final weight as W3. Calculate the total ash content using the following formula:

Total Ash Content (%) = (z-x/y) × 100

Where,
X = weight of the silica crucible
Y = weight of the drug powder (g)
Z = weight of the silica cruicible with powder ash

Acid insoluble ash

The acid-insoluble ash content measures the silica present in plant material, indicating potential contamination from soil and sand, and is crucial for assessing extract purity. To determine this, first calculate the total ash content of the Syzygium cumini and Ziziphus vulgaris extracts as described previously, recording the crucible's weight with total ash as W3. Next, add 25 mL of 10% hydrochloric acid to the crucible, cover it with a watch glass, and gently boil for 5 minutes on a hot plate. Filter the hot solution through ashless filter paper in a funnel, rinsing the crucible with hot distilled water to ensure complete transfer of ash. Wash the residue on the filter paper with hot distilled water until the filtrate is acid-free. Transfer the filter paper containing the acid insoluble residue back to the crucible and ignite it in a muffle furnace at 550°C for 1-2 hours until the paper is completely ashed and the residue is white or light gray. Finally, allow the crucible to cool in a desiccator, then weigh it and record the weight as W4. Calculate the acid insoluble ash content using the following formula:

Acid Insoluble Ash Content (%) = ((W4 −W1)/ (W2 −W1)) × 100

Where,
- W1 is the weight of the empty crucible (g)
- W2 is the weight of the crucible with the sample before ashing (g)
- W3 is the weight of the crucible with the total ash (g)

• W4 is the weight of the crucible with the acid-insoluble ash (g)

Water soluble ash

By calculating the quantity of water-soluble minerals, the water-soluble ash content, which quantifies the percentage of total ash soluble in water, aids in evaluating the quality and purity of plant material. Determine the total ash content of the Ziziphus and Syzygium cumini before beginning this test. vulgaris extracts as previously described, recording the crucible's weight with total ash as W3. Next, add 25 mL of distilled water to the crucible containing the total ash and gently boil for 5 minutes. Filter the hot solution through ashless filter paper into a pre-weighed beaker or crucible, rinsing the original crucible with hot distilled water to ensure all water-soluble ash is collected. Wash the residue on the filter paper with hot distilled water until the filtrate is free of ash, which can be confirmed by evaporating a small sample. Transfer the filter paper containing the water insoluble residue back into the original crucible and ignite it in a muffle furnace at 550°C for 1-2 hours until the paper is completely ashed and the residue is white or light gray. Finally, allow the crucible to cool in a desiccator, then weigh it and record the weight as W4. Calculate the water soluble ash content using the following formula:

Water Soluble Ash Content (%) = ((W3 –W4)/ (W2 −W1)) × 100

Where:
• W1 is the weight of the empty crucible (g)
• W2 is the weight of the crucible with the sample before ashing (g)
• W3 is the weight of the crucible with the total ash (g)
• W4 is the weight of the crucible with the water-insoluble ash (g)

Preliminary phytochemical screening of extract

Phytochemical screening is crucial for identifying bioactive compounds in Syzygium cumini and Ziziphus vulgaris extracts, providing insights into their potential therapeutic properties. The following reagents and tests can be used for this screening:

• **Alkaloids:**

Mayer’s Test: Add Mayer’s reagent to the extract; a cream or pale yellow precipitate indicates alkaloids.

Wagner’s Test: Add Wagner’s reagent; a reddish-brown precipitate indicates alkaloids.

• **Flavonoids:**

o Shinoda Test: Add magnesium turnings and hydrochloric acid; pink/red coloration indicates flavonoids.

o Alkaline Test: Add sodium hydroxide; intense yellow that fades with acid indicates flavonoids.

• **Saponins:**

o Foam Test: Shake extract with water; persistent froth indicates saponins.

• **Tannins:**

o Ferric Chloride Test: Add 0.1% ferric chloride; blue-black/green-black coloration

indicates tannins.

- **Phenols:**

o Ferric Chloride Test: Add 5% ferric chloride; deep blue/black color indicates phenols.

- **Terpenoids:**

o Salkowski Test: Add chloroform and sulfuric acid; reddish-brown interface indicates terpenoids.

- **Steroids:**

o Liebermann-Burchard Test: Add acetic anhydride and sulfuric acid; blue/green color indicates steroids.

- **Glycosides:**

o Keller-Kiliani Test: Add glacial acetic acid with ferric chloride and sulfuric acid; a brown ring indicates cardiac glycosides.

- **Carbohydrates:**

o Fehling's Test: Add Fehling's A and B; brick-red precipitate indicates reducing **sugars.**

- **Proteins:**

o Biuret Test: Add copper sulfate and sodium hydroxide; violet/pink color indicates proteins.

Experimental protocol

STZ should be freshly prepared before administration by dissolving it in cold 0.1 M citrate buffer (pH 4.5) to a concentration of 50-60 mg/kg body weight. A total of 30 mice were randomized into five groups: Group 1 (Control) received no treatment; Group 2 (Negative) received STZ (60 mg/kg) with a vehicle; Group 3 (Standard Treatment Control) received STZ (60 mg/kg) and the standard drug Glibenclamide (5 mg/kg); Group 4 received a low dose of polyherbal extract (200 mg/kg orally); and Group 5 received a high dose of polyherbal extract (400 mg/kg orally). Blood glucose levels were measured weekly using a glucometer, with blood samples collected from the tail of the mice until postmortem on days 15 and 30 of the experimental period (IEAC approval no: SIP/IEAC/0004/03/2024, dated 18/03/2024).

Biochemical studies

Rats given extracts of Syzygium Cumini seeds and Ziziphus vulgaris seeds underwent biochemical analyses to assess a range of blood parameters. Serum levels of glucose, total protein, cholesterol, ALT, AST, and urea were all thoroughly analysed after blood samples were drawn and the serum was separated by centrifugation. The accuracy and dependability of the measurements were guaranteed by the use of commercial kits. The outcomes of these experiments demonstrate the extracts' potential as a treatment by shedding light on their physiological and metabolic effects on diabetic rats.

Using a kit from Crest Biosystems in India, the glucose-oxidation (GOD/POD) method was used to quantify serum glucose. Using this process, glucose oxidase breaks down glucose into

gluconic acid and hydrogen peroxide, which when combined with peroxidase, form a colourful complex with 4-aminophenazone and hydroxybenzoate. For the method, 1 mL of working reagent was combined with 10 µL of blood serum, thoroughly mixed, and then incubated for 10 minutes at 37°C.

Using the Biuret method and a Crest Biosystems kit from India, serum protein levels were ascertained. This technique is based on the process by which proteins and cupric ions react to generate a coloured chelate in an alkaline solution. 20 µL of serum and 1 mL of Biuret reagent were combined in the procedure, and the mixture was let to remain at room temperature for ten minutes.

Serum Cholesterol was assessed using the Esterification (CHOD/PAP) method with a Crest Biosystems kit. Cholesterol esterase hydrolyzes esterified cholesterol and oxidizes it to produce hydrogen peroxide, which reacts with phenol and 4-aminoantipyrine to form a dye complex. The procedure involved adding 10 µL of blood serum to 1 mL of working cholesterol reagent, mixing well, and incubating at 37°C for 5 minutes.

ALT (Alanine Transaminase) levels were measured using an enzymatic method with DNPH reagent, utilizing a kit from Span Diagnostics Ltd, India. In this method, ALT catalyzes the conversion of α-ketoglutarate and alanine to glutamate and pyruvate. The pyruvate is coupled with 2,4-dinitrophenylhydrazine (DNPH) to form a brown-colored hydrazone. For the procedure, 0.25 mL of buffered substrate was added to 0.05 mL serum, incubated at 37°C for 30 minutes, and the reaction was stopped by adding 0.25 mL DNPH and left at room temperature for 20 minutes. Color development was achieved by adding 2.5 mL of 4N sodium hydroxide solution.

AST (Aspartate Transaminase) was also measured using an enzymatic method with DNPH reagent, employing a kit from Span Diagnostics Ltd, India. Similar to the ALT measurement, AST catalyzes the conversion of α-ketoglutarate and aspartate to oxaloacetate and glutamate, with oxaloacetate being coupled with DNPH to form a brown-colored hydrazone. The procedure followed was analogous to that of ALT, utilizing a specific buffered substrate for AST.

Result & Discussions

Physico-Chemical Evaluation of Crude Drugs

All the crude plant eaxtract underwent physical and chemical evaluations to assess various parameters. Physical evaluation is a fundamental step in identifying and standardizing crude drugs

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Physical Test of Crude Drugs

The organoleptic properties of the plant extracts were evaluated for their appearance, color, and taste. The Syzygium cumini seeds exhibited a hard and rough nature, with a dark brown color and a slightly aromatic odor, and tasted bitter. On the other hand, the Ziziphus vulgaris seeds were hard and smooth, light brown in color, had a mild odor, and tasted sweet.

Extractive Values

The extraction yields of Syzygium cumini and Ziziphus vulgaris seeds were analyzed using ethanol and water as solvents. The Syzygium cumini seeds yielded 10% w/w in ethanol extraction and 12% w/w in aqueous extraction. In comparison, the Ziziphus vulgaris seeds showed an extraction yield of 12% w/w with ethanol and 11% w/w with water. These percentages indicate the efficiency of each solvent in extracting the respective components from the seeds.

Loss on Drying and Foreign Organic Matter

For seeds of Syzygium cumini and Ziziphus vulgaris, the percentages of foreign organic matter and drying loss were measured. The foreign organic matter concentration of Syzygium cumini seeds was 1.25% w/w, while the drying loss was 6.55% w/w. By contrast, Ziziphus vulgaris seeds showed a foreign organic matter concentration of 1.51% w/w and a drying loss of 5.24% w/w. These numbers offer crucial details about the crude medications' purity and moisture content.

Total Ash, Acid Insoluble Ash and Water Soluble Ash Values

The ash values for Syzygium cumini and Ziziphus vulgaris seeds were evaluated. For Syzygium cumini seeds, the total ash value was 6.16% w/w, the water-soluble ash value was 3.05% w/w, and the acid-insoluble ash value was 2.55% w/w. In contrast, Ziziphus vulgaris seeds had a total ash value of 5.05% w/w, a water-soluble ash value of 1.26% w/w, and an acid-insoluble ash value of 1.42% w/w. These measurements provide insights into the mineral content and purity of the crude drugs, indicating the levels of both soluble and insoluble ash present.

Phytochemical Screening

Phytochemical screening was conducted on ethanol extracts of Syzygium cumini and Ziziphus vulgaris seeds to identify the presence of various compounds. For steroids and triterpenoids, Syzygium cumini tested negative in both the Liebermann's Burchard and Salkowski tests, whereas Ziziphus vulgaris tested positive in both tests. The foam test for saponins was positive for Syzygium cumini and negative for Ziziphus vulgaris. Tests for alkaloids, including Hager's and Mayer's tests, were negative for both extracts. For glycosides, both the Borntrager's and Keller Killiani tests were negative for both extracts. However, tests for tannins and phenolic compounds, including the gelatin test and the ferric chloride test, were positive for both Syzygium cumini and Ziziphus vulgaris. Similarly, tests for flavonoids, using ferric chloride

and alkaline reagent tests, were positive for both extracts. Lastly, the biuret test for proteins was negative for both Syzygium cumini and Ziziphus vulgaris extracts.

Collection of Blood and separation of Serum

Retroorbital plexus and heart puncture methods were used to get blood samples from the subjects. Following the samples' placement in tubes containing a clot activator or anticoagulant, they were centrifuged for 20 minutes at 3000 rpm in order to extract the serum from the cellular constituents. This process maintains the integrity of the serum for future precise biochemical and molecular studies. studies or clinical assessments.

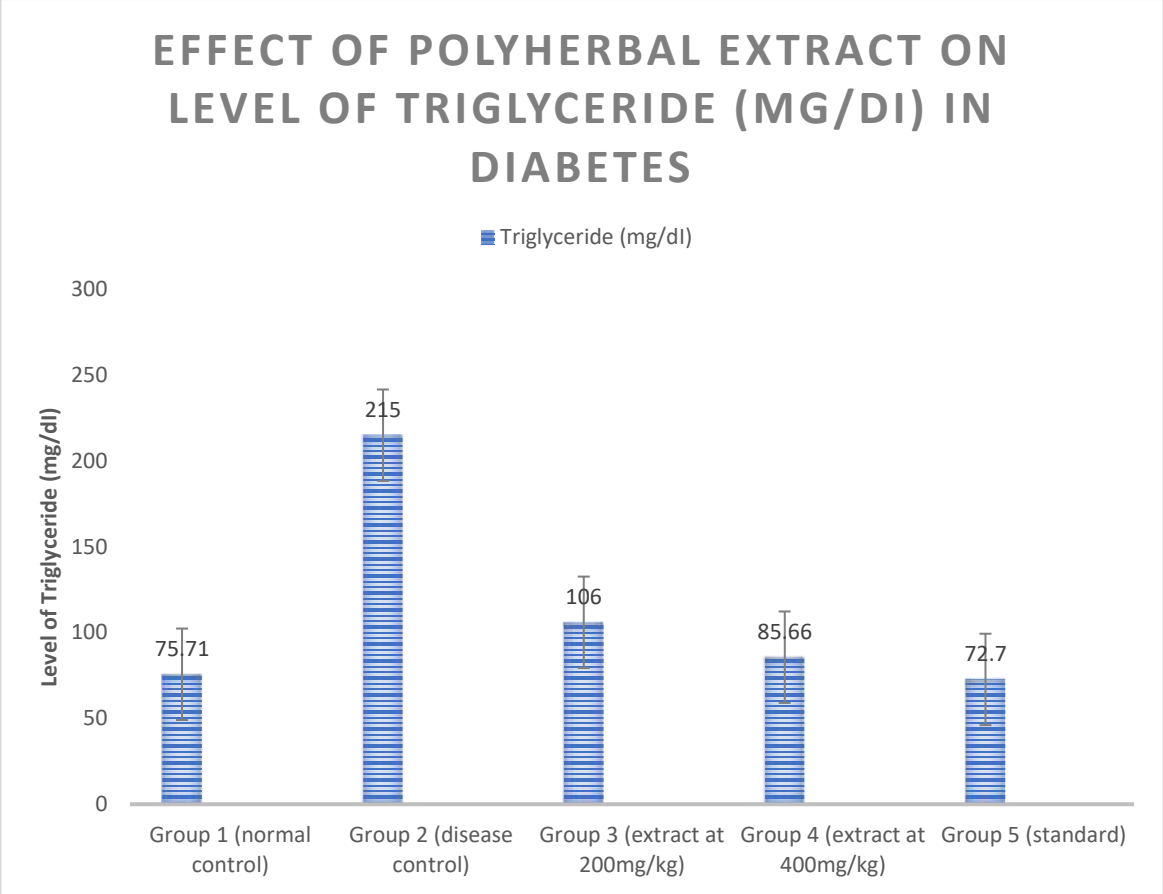
Biochemical Studies

The biochemical studies of various liver function test parameters across different groups reveal the following results:

Table: Biochemical Studies of various liver function test parameters

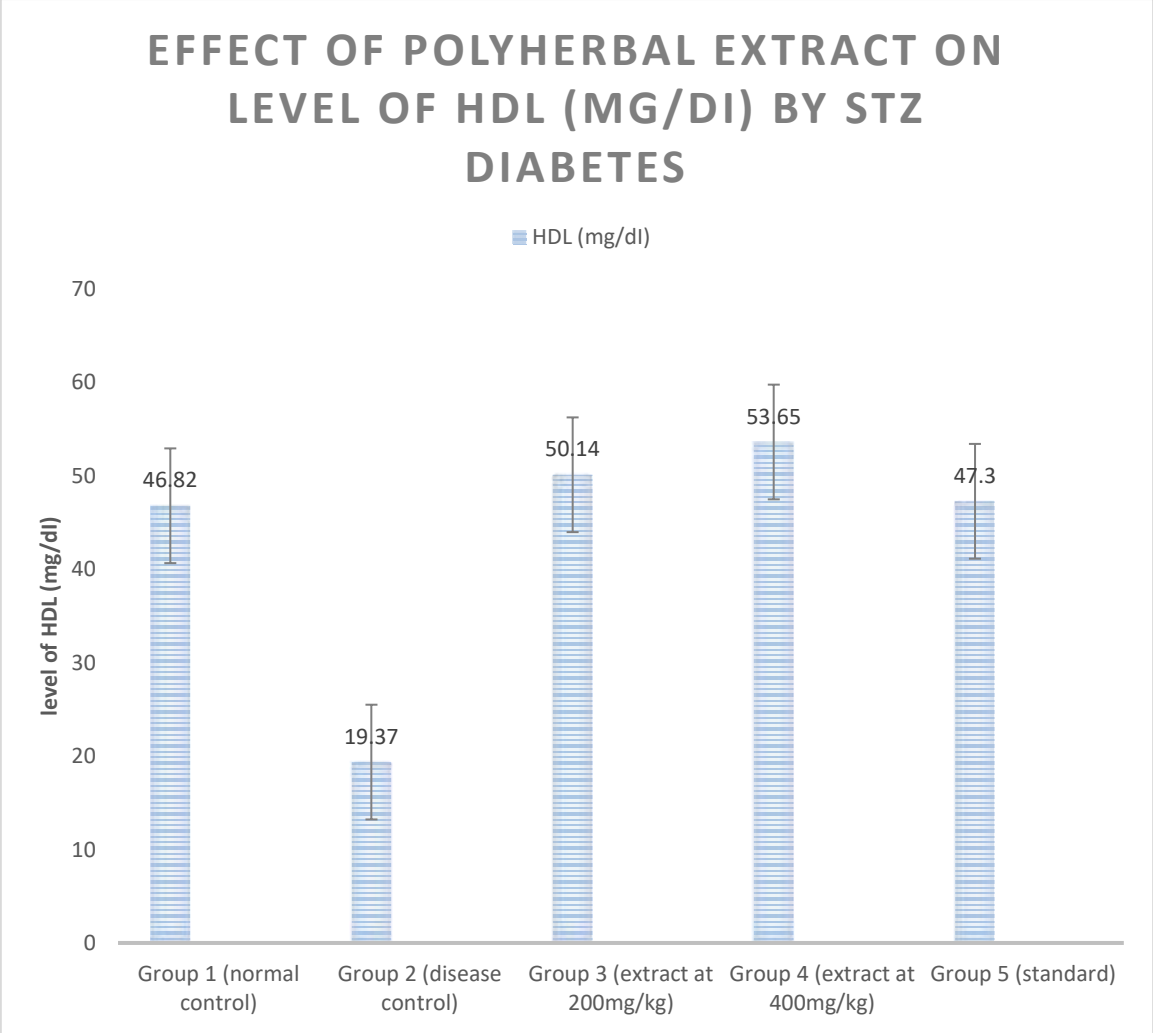
Effect of polyherbal extract on level of Triglyceride (mg/dI) in diabetes:

Group	**Dose/Kg**	**Triglyceride (mg/dI)**
Group 1 (normal control)	-	75.71±0.556
Group 2 (disease control)	60 mg/kg	215.12±3.46***
Group 3	200mg/kg	106.85±0.589
Group 4	400mg/kg	85.66±1.36
Group 5 (standard)	5 mg/kg	72.70±0.586***



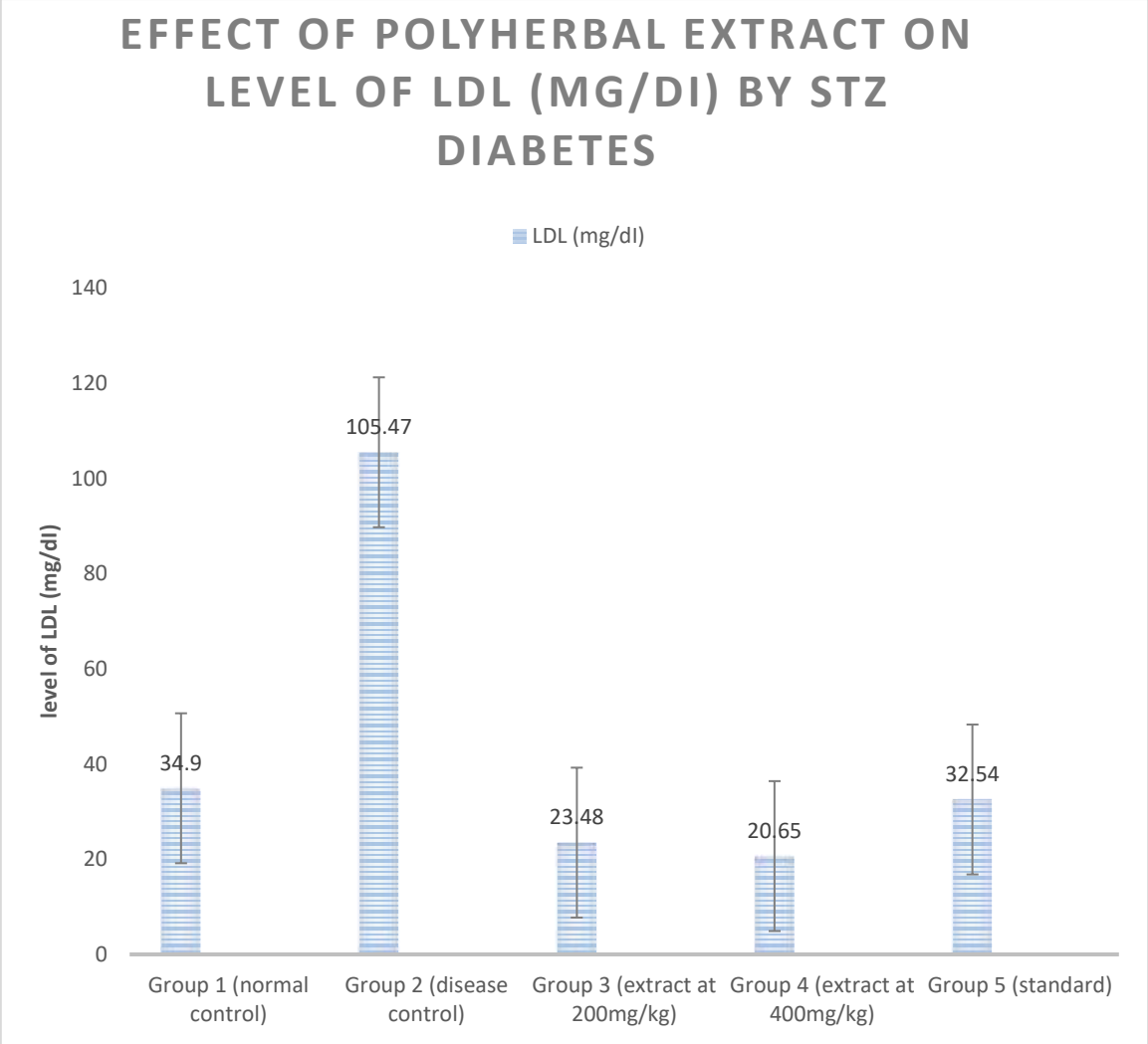
Effect of polyherbal extract on level of HDL (mg/dI) by STZ diabetes:

Group	**Dose/Kg**	**HDL (mg/dI)**
Group 1 (normal control)	-	46.82±0.854
Group 2 (disease control)	60 mg/kg	19.37±0.227***
Group 3	200mg/kg	50.14±0.347
Group 4	400mg/kg	53.65±0.198
Group 5 (standard)	5 mg/kg	47.30±0.339***



Effect of polyherbal extract on level of LDL (mg/dl) by STZ diabetes:

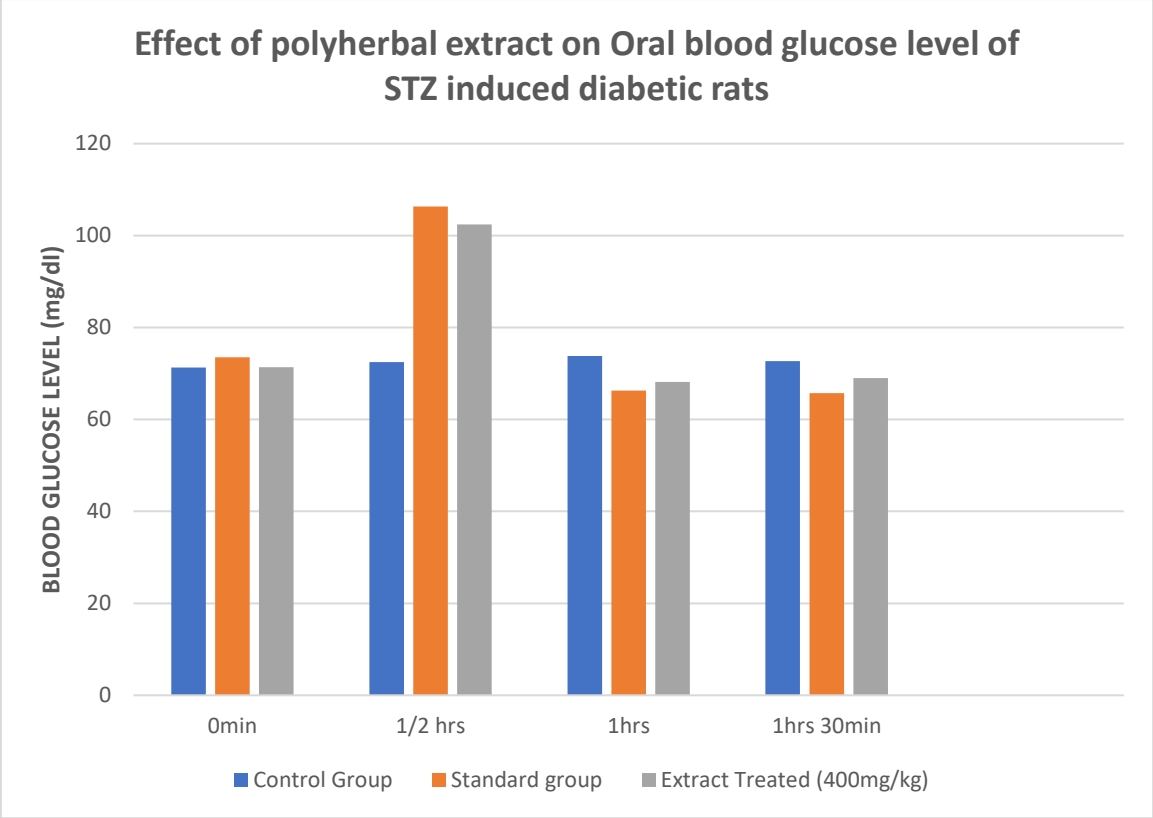
Group	**Dose/Kg**	**LDL (mg/dl)**
Group 1 (normal control)	-	34.9±0.4571
Group 2 (disease control)	60 mg/kg	105.47±0.258741***
Group 3	200mg/kg	23.4875±0.6584824
Group 4	400mg/kg	20.65±0.2748736
Group 5 (standard)	5 mg/kg	32.547±0.942574***



All the Data is expressed as mean ± SEM n=5 *p<0.01 compared to vehicle treated group One way ANOVA followed by hoc Dunnett's test were performed.

Effect of polyherbal extract on Oral blood glucose level of STZ induced diabetic rats:

BLOOD GLUCOSE LEVEL (mg/dl) MEN±SEM					
Group	**Dose**	**0 min**	**½ hrs.**	**1hrs**	**1hrs 30min**
Group 1 (control)	-	72.28±0.22	73.5±0.32	74.8±0.02	74.66±0.42
Group 2 (standard)	5mg/kg	74.55±0.42	107.32±0.64	67.25±0.14	66.74±1.08*
Group 3 (extract treated)	400mg/kg	71.36±0.28	103.45±0.21	69.18±0.32	70.01±1.02*



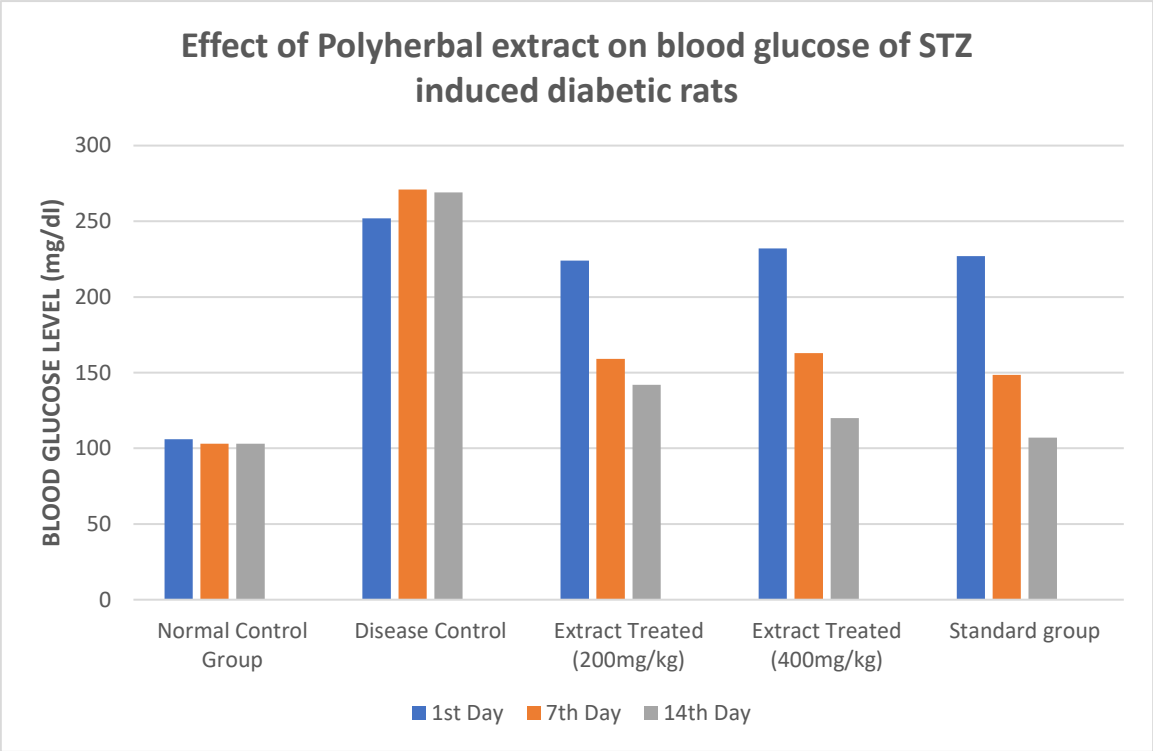
Effect of polyherbal extract on body weight of STZ induced diabetic rats

The screening of anti-diabetic action of test drugs, based on body weight is summarized as follows:

Effect of Polyherbal extract on blood glucose of STZ induced diabetic rats:

Groups	**Dose**	**BLOOD GLUCOSE LEVEL (mg/dl) MEN±SEM**		
		1st Day	7th Day	14th Day
Group 1 (Normal Control)	2ml	106±1.45	103±1.14	103±1.35
Group 2 (Disease Control)	60 mg/kg	252±13.22***	271.3±13.00***	269±13.006***
Group 3 (Standard Drug)	5 mg/kg	224±3.55	159±12.14**	141±2.36**
Group 4 Low Dose PHPE (200 mg/kg)	200 mg/kg	232±1.41	163±2.3***	120±1.65***

Group 5 High Dose PHPE (400 mg/kg)	400 mg/kg	227±5.02	148.5±1.65***	107.55±1.58***



Conclusion

The study evaluated the biochemical and physiological effects of plant extracts from Syzygium cumini and Ziziphus vulgaris on STZ-induced diabetic rats. Biochemical analysis revealed elevated levels of ALT and AST in some groups, indicating potential liver stress, while totalprotein, creatinine, and urea levels varied, suggesting differing impacts on kidney function. Physical assessment showed fluctuations in body weight, reflecting the extracts' effects on metabolism. Phytochemical screening indicated the presence of flavonoids and saponins, likely contributing to the observed physiological changes. Liver function tests showed significant variability, with Group 1 exhibiting normal levels and Group 5 displaying high SGPT and SGOT levels, indicating liver damage. Kidney function tests revealed normal parameters in Group 1, while Groups 4 and 5 showed signs of kidney stress. The lipid profile indicated variations in cholesterol and triglyceride levels across groups, with Group 1 having the healthiest profile. Fasting blood glucose levels demonstrated effective glucose regulation in Groups 3, 4, and 5, especially at higher doses of PHPE, suggesting promising anti-diabetic effects. Overall, the study highlights the potential therapeutic benefits of these plant extracts in managing diabetes, warranting further investigation into their mechanisms and long-term effect

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article. The research was conducted without any financial or personal relationships that could influence the findings.

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