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

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ABSTRACT

This study aimed to evaluate the biochemical, physiological, and anti-diabetic effects of *Syzygium cumini* (seeds) and *Ziziphus vulgaris* (seeds) extracts in streptozotocin (STZ)-induced diabetic rats. A total of 30 STZ-induced diabetic rats were randomized into five groups: 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). Blood samples were collected weekly to assess fasting blood glucose, and various biochemical parameters were analyzed, including serum glucose, ALT, AST, total protein, cholesterol, creatinine, and urea levels. Treatment with *Syzygium cumini* and *Ziziphus vulgaris* extracts significantly lowered fasting blood glucose levels in diabetic rats compared to the negative control. Biochemical analyses revealed improved liver function indicators, including reduced ALT and AST levels, particularly in groups treated with the high dose of polyherbal extract (PHPE). Kidney function markers showed varying levels across groups, with significant improvements in creatinine and urea levels observed in the treatment groups. The findings of this study suggest that *Syzygium cumini* and *Ziziphus vulgaris* extracts possess anti-diabetic properties and may ameliorate biochemical and physiological disturbances in STZ-induced diabetic rats. These results support the potential therapeutic application of these plant extracts in managing diabetes and its complications, warranting further investigation into their mechanisms of action and long-term effects.

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

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia due to impaired insulin secretion, insulin action, or both. It has become a global health concern, leading to severe complications such as neuropathy, nephropathy, retinopathy, cardiovascular diseases, and impaired wound healing.[1] Among the different types of diabetes, Type 1 diabetes results from autoimmune destruction of pancreatic β-cells, while Type 2 diabetes is primarily caused by insulin resistance.[2]

Conventional treatments for diabetes typically involve insulin injections and oral hypoglycemic agents, which help regulate blood glucose levels. However, these treatments often come with various side effects, including hypoglycemia, gastrointestinal disturbances, and long-term complications. As a result, there is an increasing interest in alternative therapies, especially those derived from natural sources, for managing diabetes effectively.[3]

In recent years, the use of herbal remedies and polyherbal formulations has gained prominence in the search for safer and more effective treatments for diabetes. Plants rich in bioactive compounds such as flavonoids, alkaloids, phenolic acids, and terpenoids have shown promising antidiabetic properties. Polyherbal formulations, which combine multiple plant extracts, offer a synergistic effect that can enhance therapeutic efficacy and reduce adverse effects compared to single-drug therapy.[4,5]

Streptozotocin (STZ)-induced diabetes in rats is a widely used experimental model for studying the pathophysiology of diabetes and evaluating the potential antidiabetic effects of natural compounds.[6] STZ selectively destroys pancreatic β-cells, mimicking the effects of Type 1 diabetes in humans, and serves as a reliable method for assessing hypoglycemic agents.[7]

In this study, the antidiabetic activity of a polyherbal extract will be evaluated using STZ-induced diabetic rats. The polyherbal formulation, comprising different medicinal plants with reputed antidiabetic properties, is hypothesized to lower blood glucose levels, improve insulin sensitivity, and mitigate oxidative stress in diabetic conditions.[8] The findings of this study could provide valuable insights into the potential of polyherbal therapies as alternative treatments for diabetes.[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]

The combination of *Ziziphus vulgaris* and *Syzygium cumini* seeds in polyherbal formulations presents a promising approach for diabetes management. The synergistic effects of their bioactive compounds can enhance blood glucose regulation and provide protection against oxidative stress, thus reducing the risk of diabetic complications. This study will evaluate the antidiabetic potential of these polyherbal extracts in STZ-induced diabetic rats.

Material & Methods

Material Used

The materials used in the study include Syzygium cumini and Ziziphus vulgaris seeds obtained from the botanical garden. Dragendorff’s reagent was sourced from the college lab, while streptozotocin was purchased from a nearby shop. Distilled water and other chemicals were also obtained from the college lab. Various diagnostic kits, including cholesterol, AST, creatinine,

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.

Instrument Used

The instruments used in this study include several essential pieces of equipment sourced primarily from the college laboratory. These include a hot plate, BOD incubator, glucometer, muffled furnace, vacuum evaporator, digital weighing balance, pH meter, vortex shaker, test tubes, and beakers. Additionally, an electric homogenizer was procured from Ever Shine (Model No: 607), and a cold centrifuge machine (Model No: C-24 BL) as well as a micro-centrifuge (also Model No: C-24 BL) were supplied by Remi.

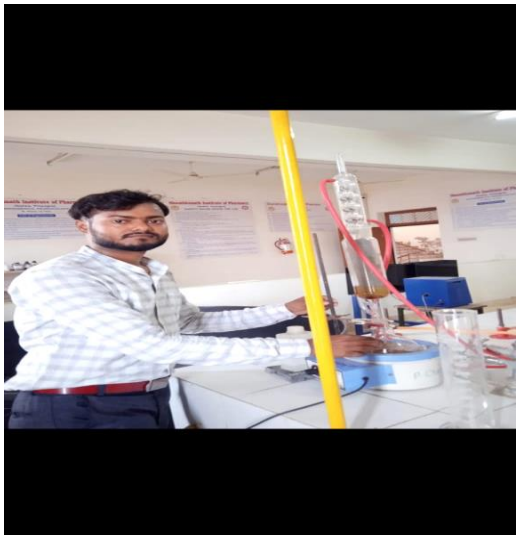
Collection and Authentication of Crude Drugs

The raw ingredients for the polyherbal mixture, including Syzygium cumini and Ziziphus vulgaris seed extracts, were sourced from a neighboring Kadipur nursery in Sultanpur. A botanist verified the seeds on April 4, 2024, using the Botanical Survey of India reference letter No. SIP/2024/101-G. Streptozotocin was provided by a local pharmacist. All reagents used were of analytical quality, and the college supplied the calibrated instruments following standard operating protocols.

Preparation of Plant extracts from plants

Fresh *Syzygium cumini* and *Ziziphus vulgaris* seeds were collected and authenticated by a botanist. After washing with distilled water, the seeds were air-dried for 7-10 days and ground into a fine powder. For extraction, approximately 100 grams of the powdered seeds were placed in a thimble in a Soxhlet extractor filled with 500 mL of ethanol. The apparatus was connected to a condenser, and the heating mantle was activated to heat the ethanol, allowing it to evaporate and condense in the thimble, where it extracted the plant constituents. This process continued for 6-8 hours until the solvent in the siphon tube became colorless. After cooling, the thimble was removed, and the extract was filtered through Whatman No. 1 filter paper. It was concentrated using a rotary evaporator, transferred to a petri dish, and dried at room temperature or in a

vacuum 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

Organoleptic evaluation assesses the sensory properties of Syzygium cumini and Ziziphus vulgaris extracts, including appearance, color, odor, taste, and texture, to ensure quality and acceptability. The procedure begins with placing a small, measured amount of each extract on clean glass plates or petri dishes at room temperature. A panel of trained evaluators familiar with sensory techniques is assembled, each provided with a sensory evaluation form for recording observations. Evaluators examine the extracts based on criteria such as appearance, noting the physical form; color, ranging from light green to dark brown; odor, describing the aroma; taste, if safe to sample; and texture, assessing 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

Determining total ash content is a standard method for measuring the mineral content in plant material, helping assess the quality, purity, and potential adulteration of the extract. To perform this test, first, allow a crucible to cool in a desiccator, then weigh it using an analytical balance and record this weight as W1. Accurately weigh 2-3 grams of the Syzygium cumini and Ziziphus vulgaris seed extract, transferring it to the pre-weighed crucible, and record the combined weight as Z. Place the crucible in a muffle furnace and gradually increase the temperature to 550°C, maintaining this for 4-6 hours until a white or light gray ash is obtained. 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:

$$\textbf{Total Ash Content (\%)} = (z\text{-}x/y) \times 100$$

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:

$$\textbf{Acid Insoluble Ash Content (\%)} = \textbf{((W4 } - \textbf{W1)/ (W2 } - \textbf{W1)) } \times \textbf{ 100}$$

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

The water-soluble ash content measures the portion of total ash soluble in water, helping assess the quality and purity of plant material by determining the amount of water-soluble minerals. To perform this test, first, calculate the total ash content of the Syzygium cumini and Ziziphus

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:

$$\text{Water Soluble Ash Content (\%)} = (\mathbf{(W3 - W4)/ (W2 - W1)) \times 100}$$

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:**
  - *Shinoda Test:* Add magnesium turnings and hydrochloric acid; pink/red coloration indicates flavonoids.
  - *Alkaline Test:* Add sodium hydroxide; intense yellow that fades with acid indicates flavonoids.
- **Saponins:**
  - *Foam Test:* Shake extract with water; persistent froth indicates saponins.
- **Tannins:**
  - *Ferric Chloride Test:* Add 0.1% ferric chloride; blue-black/green-black coloration indicates tannins.
- **Phenols:**
  - *Ferric Chloride Test:* Add 5% ferric chloride; deep blue/black color indicates phenols.
- **Terpenoids:**
  - *Salkowski Test:* Add chloroform and sulfuric acid; reddish-brown interface indicates terpenoids.
- **Steroids:**
  - *Liebermann-Burchard Test:* Add acetic anhydride and sulfuric acid; blue/green color indicates steroids.
- **Glycosides:**

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

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

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

Fig: Induction of experimental diabetes in rats


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

Biochemical studies were conducted to evaluate various serum parameters in rats treated with Syzygium Cumini (seeds) and Ziziphus vulgaris (seeds) extract. Blood samples were collected, and the serum was separated by centrifugation, providing a comprehensive analysis of serum glucose, total protein, cholesterol, ALT, AST, and urea levels. The use of commercial kits ensured the reliability and accuracy of the measurements. The results from these tests contribute to understanding the metabolic and physiological effects of the extracts on diabetic rats, highlighting their therapeutic potential.

Serum Glucose was measured using the glucose-oxidation (GOD/POD) method with a kit from Crest Biosystems, India. In this method, glucose oxidase converts glucose to gluconic acid and hydrogen peroxide, which, in the presence of peroxidase, forms a colored complex with hydroxybenzoate and 4-aminophenazone. For the procedure, 10 µL of blood serum was added to 1 mL of working reagent, mixed well, and incubated at 37°C for 10 minutes.

Serum Protein levels were determined using the Biuret method, also with a kit from Crest Biosystems, India. This method relies on the reaction of peptide bonds in proteins with cupric ions in an alkaline medium to form a colored chelate. In this procedure, 1 mL of Biuret reagent was mixed with 20 µL of serum and allowed to stand at room temperature for 10 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.

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

The loss on drying and foreign organic matter percentages for Syzygium cumini and Ziziphus vulgaris seeds were assessed. For Syzygium cumini seeds, the loss on drying was 6.55% w/w and the foreign organic matter content was 1.25% w/w. In comparison, Ziziphus vulgaris seeds exhibited a loss on drying of 5.24% w/w and a foreign organic matter content of 1.51% w/w. These values provide important information on the moisture content and purity of the crude drugs.

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

Blood samples were collected from individuals using retro-orbital plexus and heart puncture techniques. After placing the samples in tubes with an anticoagulant or clot activator, they were centrifuged at 3000 rpm for 20 minutes to separate the serum from cellular components. This procedure preserves serum integrity for accurate biochemical and molecular analyses in future research or clinical evaluations.

5.4 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

Groups	**TOTAL S.Bilirubin (mg/dl)**	**SGPT (IU/L)**	**SGOT (IU/L)**	**Serum alkaline phosphates (IU/L)**	**Total Protein (mg/dl)**	**Serum albumin (mg/dl)**
Group 1	0.4	30	40	150	7.5	3.5
Group 2	0.99	37.0	306.0	209.3	8.0	3.0
Group 3	0.44	22.3	35.7	109.3	7.8	3.8
Group 4	1.2	77.3	72.1	180.0	7.1	3.8
Group 5	0.64	146.6	140.0	191.6	7.7	3.6

Screening of anti-diabetic action of test drugs

The effect of plant extracts on kidney function test parameters in STZ-induced diabetic rats after two weeks is summarized as follows:

Table: **The effect of plant extracts test parameters in STZ induced diabetic rats after 2 weeks of kidney function test.**

Groups	**Creatinine (mg/dL)**	**Urea (mg/dL)**	**Uric acid mg/dL**	**Serum Sodium mmol/L**	**Serum Potassium mmol/L**
Group 1	0.72	20	3.5	135	5.0
Group 2	0.58	24.5	2.9	137.1	7.8
Group 3	0.64	20.8	2.8	142.1	6.5
Group 4	1.2	47.4	7.7	132.5	5.8
Group 5	0.68	37.8	1.2	138.5	6.8

Screening of anti-diabetic action of test drugs

The lipid profile test results across different groups are as follows:

Lipid profile tests:

Groups	**S.Cholestrol (mg/dl)**	**HDL Cholestrol (mg/dl)**	**LDL Cholestrol (mg/dl)**	**VLDL Cholestrol (mg/dl)**	**S. Trigyceride (mg/dl)**
Group 1	155	30	95	15.5	90
Group 2	166.2	24.4	122.78	19.02	95.5
Group 3	162.7	28.2	116.4	18.1	90.5
Group 4	156.2	41.0	91.1	24.1	120.5
Group 5	134.7	40	74.1	20.1	100.5

Screening of anti-diabetic action of test drugs

The screening of anti-diabetic action of test drugs, based on fasting blood glucose levels, is summarized as follows:

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

Groups	**After 0 Days (mg/dl)**	**After 3 Days (mg/dl)**	**After 6 Days (mg/dl)**	**After 9 Days (mg/dl)**	**After 12 Days (mg/dl)**	**After 15 Days (mg/dl)**
Group 1 (Normal Control)	86	88	81	82	80	89
Group 2 (Disease Control)	240	256	258	250	240	255
Group 3 (Standard Drug)	245	210	190	160	150	72
Group 4 Low Dose PHPE (200 mg/kg)	243	214	195	162	110	72
Group 5 High Dose PHPE (400 mg/kg)	252	209	172	140	102	69

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	**After 0 Days (gm)**	**After 5 Days (gm)**	**After 10 Days (gm)**	**After 15 Days (gm)**
Group 1 (Normal Control)	150	149	146	144
Group 2 (Disease Control)	110	100	98	97
Group 3 (Standard Drug)	110	95.4	96.5	99.7
Group 4 Low Dose PHPE (200 mg/kg)	140	110	99.8	96.5
Group 5 High Dose PHPE (400 mg/kg)	143	112	96.5	97.3

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 total

protein, 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 effects.

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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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