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Evaluate the antidiabetic and hypolipidemic potential of the hydroalcoholic extract of *crateva magna* root (haecmr) and *eugenia jambolana* seed in streptozotocin (stz)-induced diabetic rats

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ABSTRACT

The present study aimed to evaluate the antidiabetic and hypolipidemic potential of the hydroalcoholic extract of *Crateva magna* root (HAECMR) and *Eugenia jambolana* seed in streptozotocin (STZ)-induced diabetic rats. Plant materials were collected from the Bhopal region of Madhya Pradesh, India, and authenticated. Extraction was performed using 70% ethanol via Soxhlet apparatus. Preliminary phytochemical screening confirmed the presence of flavonoids, alkaloids, glycosides, tannins, terpenoids, and saponins. Acute oral toxicity was assessed according to OECD-423 guidelines, establishing safety up to 300 mg/kg body weight.Thirty male Wistar rats were divided into five groups and treated for 21 days. Diabetes was induced using STZ, and animals were treated with HAECMR at two doses (100 and 300 mg/kg), Glibenclamide (10 mg/kg), or left untreated (diabetic control). Biochemical parameters including blood glucose, total cholesterol, triglycerides, HDL, LDL, and VLDL were measured at regular intervals. The Oral Glucose Tolerance Test (OGTT) was also performed to assess glucose clearance.Results indicated that HAECMR significantly reduced fasting blood glucose and improved lipid profiles in a dose-dependent manner. The 300 mg/kg dose showed effects comparable to Glibenclamide. Treated groups also exhibited improved plasma insulin levels and recovery of body weight. The observed pharmacological activities are likely attributed to the phytoconstituents identified in the extract.

Keywords: *Crateva magna*, *Eugenia jambolana*, antidiabetic activity, hypolipidemic effect, streptozotocin, phytochemical screening, OGTT

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1. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is a growing global health concern, affecting millions of individuals and leading to serious complications such as cardiovascular disease, neuropathy, nephropathy, and retinopathy. The World Health Organization (WHO) has projected diabetes to be one of the leading causes of death worldwide by 2030 **(Watkins et al., 2003).** Despite the availability of various synthetic antidiabetic agents, their long-term use is often associated with adverse effects, limited efficacy, and high cost, necessitating the exploration of alternative therapies **(Khatun et al., 2015).**

Herbal medicine has gained increasing attention as a complementary or alternative approach for the management of diabetes, owing to its perceived safety, efficacy, and affordability. A large number of medicinal plants have been traditionally used in Ayurvedic and folk medicine for their antidiabetic properties. Among these, *Crateva magna* (family: Capparidaceae) and *Eugenia jambolana* (syn. *Syzygium cumini*, family: Myrtaceae) are well-documented in traditional medicine for managing metabolic disorders **(Jacobs et al., 1964).**
Crateva magna, commonly known as "Varuna," is traditionally used in the treatment of urinary disorders, inflammation, and diabetes. It contains a variety of bioactive compounds such as flavonoids, tannins, saponins, and glycosides, which are believed to contribute to its therapeutic effects. Eugenia jambolana, commonly referred to as “Jamun” or “Black Plum,” is also known for its antidiabetic, antioxidant, and hypolipidemic properties. Its seeds are particularly rich in alkaloids, flavonoids, and phenolic compounds **(Kher et al., 2016).**
The present study was designed to evaluate the antidiabetic and hypolipidemic potential of the hydroalcoholic extract of *Crateva magna* root (HAECMR) and *Eugenia jambolana* seed, individually and in combination, in streptozotocin (STZ)-induced diabetic rats. The study also aimed to assess the safety of these extracts via acute toxicity testing and to identify their phytochemical constituents. The findings may contribute to the scientific validation of these traditionally used plants and offer insight into their potential for development as herbal antidiabetic agents.

2. MATERIALS AND METHODS

2.1 PLANT MATERIAL

The root of *Crateva magna* and seeds of *Eugenia jambolana* were collected from the Bhopal region, Madhya Pradesh, India, during the month of May. The plant materials were authenticated at Safia College of Science, Bhopal, Madhya Pradesh.

2.2 Extraction of plant material

The root was shade dried and powdered coarsely. The coarse powder obtained wasextracted exhaustively with 70% ethanol in soxhlet apparatus and filtered. The extract wasconcentrated under temperature and pressure to get dry residue and stored in a desicators. The same method has applied to seeds also.

2.3 Phytochemical screening of hydroalcoholic root extract

Preliminary phytochemical analysis was carried out to identify the phytoconstituents present in the crude extract. *Crateva magna* showed the presence of glycosides, tannins, saponins, terpenoids, and flavonoids.
The hydroalcoholic extracts of *Crateva magna* and *Eugenia jambolana* seeds underwent preliminary phytochemical screening, revealing the presence of several key bioactive

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compounds. Alkaloids were confirmed through various standard tests such as Dragendorff's, Mayer's, and Wagner's. Amino acids and proteins were detected using Millon's, Ninhydrin, Biuret, and Xanthoprotein tests. Carbohydrates, including monosaccharides, ketoses, and pentoses, were identified using Molisch's, Barfoed's, Selivanoff's, and Benedict's tests. Flavonoids were indicated by color changes in Shinoda, alkaline reagent, and zinc hydrochloride tests. Glycosides were confirmed through comparative acid and water extraction tests. Tannins and other phenolic compounds were present as evidenced by ferric chloride and gelatin tests, including specific detection of catechins. Finally, steroids and terpenoids were identified using Liebermann–Burchard and Salkowski tests. Overall, the results indicate a rich phytochemical profile, supporting the medicinal potential of both plant extracts.

2.4 Acute toxicity study

When a chemical substance is administered to a biological system, it can trigger various dose-related responses—some beneficial and others potentially harmful. To evaluate a new drug's safety, pharmaceutical companies conduct toxicity tests, including acute, sub-acute, and chronic studies.

Acute toxicity testing, often the first step in toxicological evaluation, helps determine the median lethal dose (LD_{50}), indicating the dose lethal to 50% of test animals. This assessment is essential for classifying substances before regulatory approval.

The Organisation for Economic Co-operation and Development (OECD) regulates guidelines for acute oral toxicity. It is an international organization that aims to reduce both the number of animals used and the level of pain associated with acute toxicity testing. To determine acute toxicity, the OECD has established the following guideline methods:

2.4.1 Acute Oral Toxicity:

Acute oral toxicity refers to adverse effects occurring following oral administration of a single dose of a substance or multiple doses given within 24 hours.

2.4.2 LD_{50} (Median Lethal Dose):

LD_{50} is a statistically derived single dose of a substance that is expected to cause death in 50% of the test animals when administered orally. The LD_{50} value is expressed in terms of the weight of the test substance per unit weight of the test animal (mg/kg).

2.4.3 Selection of animal species

The preferred rodent species was the rat. Normally, females were used, as they are generally slightly more sensitive. Healthy young adult animals of commonly used laboratory strains should be employed. Females should be nulliparous and non-pregnant. Each animal, at the commencement of its dosing, should be between 8 to 12 weeks old.

2.4.4 Administration of Doses

The test substance was given as a single oral dose after fasting animals for 3–4 hours (food withheld but not water). Animals were monitored closely for 14 days, especially during the first 24 hours, to observe any toxic effects, with records kept for each animal. Observation duration could be extended based on the onset and recovery of toxicity signs. Following OECD 423 guidelines, doses were selected based on the maximum tolerated dose, with 300 mg/kg as the high dose and 100 mg/kg as the low dose, a procedure also applied to *Eugenia jambolana*.

2.5 Evaluation of Antidiabetic, Hypolipidemic activity

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Thirty male rats, 6 weeks old and weighing roughly above 150 g, were procured from Nishka Labs and were housed in polypropylene cages in a temperature-controlled room (25 ± 2˚C) with a 12 h light/12 h dark cycle. All rats were adapted and fed a standard pellet diet for 1 week. Rats had unrestricted access to food and water. Food intake was monitored daily, and body weights measured weekly. All rats were randomly divided into five groups (n = 6):
Group I served as the normal control group. Group II was the diabetic control group fed with STZ. Group III consisted of the STZ-treated group receiving the standard drug Glibenclamide at 10 mg/kg orally. Group IV was the STZ-treated group administered Crateva magna root extract at 100 mg/kg orally. Group V included the STZ-treated group given Crateva magna root extract at 300 mg/kg orally **(Kalarani et al., 2009; Lolitkar and Rao et al., 1962).**
All the above groups were treated for 21 days and rats were maintained in accordance with the CPCSEA guidelines for the care and use of laboratory animals. The same procedure was followed for *Eugenia jambolana* seed and 1:1 combination of *Crateva magna* root and *Eugenia jambolana* seed.

2.5.1 Blood and tissue collection:

At the end of the study, blood samples were collected in heparinized tubes by puncturing the orbital venous plexus of 12-hour fasted and anesthetized (slight exposure to ether) rats. Whole blood samples were centrifuged at 4500 rpm for 10 minutes at 4˚C, and plasma was separated and stored at -70˚C until further analysis. All the animals were sacrificed by cervical dislocation. The liver and pancreas were removed, rinsed with chilled phosphate-buffered saline (pH 7.0), and weighed.

Picture 5: Retro-orbital bleeding technique

2.6 Estimation of biochemical parameters

The biochemical parameters were estimated using commercially available kits. According to the manufacturer's protocol, the following parameters — glucose (by Accu-Chek Active), total cholesterol, triglycerides, HDL, LDL, and VLDL — were estimated using an auto-analyser in PBRI (**Chanda et al., 1988).**

.i. Estimation ofglucose

The glucose levels are estimated by collecting the blood samples. Small amount of blood wasobtained from tail vein of rat. By placing a drop of blood on glucometer strip there by the stripwas inserted into the glucometer where it displaces the glucose level in the drop of blood inmg/dl.

ii. Estimation of total cholesterolMethodCholesteroloxidase-peroxidase

At the end of the study, blood samples were collected from 12-hour fasted, lightly ether-anesthetized rats via orbital venous plexus puncture into heparinized tubes. The collected whole blood was centrifuged at 4500 rpm for 10 minutes at 4°C to separate plasma, which was then stored at -70°C for further analysis. The rats were euthanized by cervical dislocation, after which the liver and pancreas were excised, rinsed with chilled phosphate-buffered saline (pH 7.0), and weighed.

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For biochemical analysis, an endpoint colorimetric assay was used. The reagent was pre-warmed to room temperature before use. In labeled test tubes, 10 µL of serum (sample), 10 µL of standard (200 mg/dL), or no sample (blank) was added to 1000 µL of reagent. All tubes were mixed thoroughly and incubated for either 5 minutes at 37°C or 10 minutes at room temperature (25°–30°C). Absorbance was measured at 510 nm using the blank for zero setting. The assay was linear up to 1000 mg/dL, with a blank absorbance limit of 0.300. The resulting color was stable for up to two hours when protected from light **(Kant et al., 2011).**

iii. Estimation of triglycerides

a. Triglycerides

Triglyceride Estimation Summary (GPO-PAP Method)

Triglycerides were measured using the Glycerol-3-Phosphate Oxidase–Peroxidase (GPO-PAP) enzymatic method. In this assay, triglycerides in the sample are first hydrolyzed by lipoprotein lipase (LPL) into glycerol and free fatty acids. Glycerol is then phosphorylated by glycerol kinase (GK) using ATP to form glycerol-3-phosphate, which is oxidized by glycerol-3-phosphate oxidase (GPO) to produce dihydroxyacetone phosphate and hydrogen peroxide (H_2O_2). The H_2O_2 reacts with 4-aminoantipyrine and 4-chlorophenol in the presence of peroxidase (POD) to form a red quinoneimine dye. The intensity of the color, measured at 505 nm, is directly proportional to the triglyceride concentration.

The analyzer was programmed according to assay parameters. It was first zeroed using the reagent blank. Absorbance of the standard and then the test sample was measured. Triglyceride concentration in the serum was calculated using the formula:

Serum triglycerides (mg/dL) = (Absorbance of test / Absorbance of standard) × 200.

b. HDL

HDL cholesterol was estimated using the Polyethylene Glycol-CHOD-PAP method with a lipid clearing factor (LCF). In this method, very low-density (VLDL) and low-density lipoproteins (LDL) were precipitated using a reagent containing PEG 6000, allowing only high-density lipoproteins (HDL) to remain in the supernatant. HDL cholesterol in the supernatant was then measured through a series of enzymatic reactions. Cholesterol oxidase catalyzed the oxidation of cholesterol to cholestenone, producing hydrogen peroxide. This was followed by a peroxidase-catalyzed reaction where hydrogen peroxide reacted with 4-aminoantipyrine and phenol to form a red quinoneimine dye. The intensity of the color, measured at 505 nm, was directly proportional to the HDL cholesterol concentration in the sample. The assay was performed at 37°C, using 100 µL of sample and 1000 µL of reagent. The absorbance was read within 60 minutes of color development. A standard solution of HDL cholesterol (50 mg/dL) was used for calibration. The HDL cholesterol concentration in the sample was calculated using the formula:

HDL cholesterol (mg/dL) = (Absorbance of Test / Absorbance of Standard) × 50 × 2

c. VLDL

The VLDL was calculated using the following formula: VLDL (mg/dL) = Triglycerides / 5

d. LDL

The LDL was calculated using the following formula: LDL (mg/dL) = Total Cholesterol – (HDL + VLDL)

The Oral Glucose Tolerance Test (OGTT) is used to assess impaired glucose tolerance, a key feature of diabetes mellitus. It involves measuring blood glucose levels after an overnight fast and following an oral glucose load. In this study, OGTT was conducted on diabetic-induced

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rats divided into five groups: normal control, diabetic control, a group treated with standard glibenclamide (10 mg/kg), and two groups treated with HAECMR at doses of 100 mg/kg and 300 mg/kg, respectively, along with glucose. Sixty minutes after drug administration, all groups received an oral glucose load (2 g/kg), and blood glucose levels were measured at 0, 30, 60, 90, and 120 minutes using an Accu-Chek Advantage glucometer. The test evaluated the antihyperglycemic effects of HAECMR by monitoring how effectively blood glucose levels returned toward normal.

2.7 EXPERIMENTAL DESIGN

Five groups of rats, six in each group, received the following treatment schedule for 21 days:

- **Group I: Normal control**
- **Group II: STZ-treated control**
- **Group III: STZ + Glibenclamide (10 mg/kg; p.o.)**
- **Group IV: STZ + HAECMR (100 mg/kg; p.o.)**
- **Group V: STZ + HAECMR (300 mg/kg; p.o.)**

The root extract of *Crateva magna* and the standard drug were administered using an oral feeding needle.

STZ – Streptozotocin

HAECMR – Hydroalcoholic extract of *Crateva magna* root

Fasting blood samples were drawn from the retro-orbital venous plexus of rats at four intervals (each interval = 7 days) for a total duration of 21 days: on days 0, 7, 14, and 21.

2.8 Estimation of biochemical parameters

On days 0, 7, 14, and 21, fasting blood samples were collected, serum was separated, and analyzed for glucose. On days 1, 12, 24, 36, and 48, serum was analyzed for total cholesterol, triglycerides, HDL, VLDL, LDL, and plasma insulin levels **(Gadpandey et al.., 1995).**

2.8.1 Evaluation of Body Weight

Body weights of all the animals in each group were measured during the study period—initially before the start of the study and finally at the end of the study **(Jhansi et al., 1994).**

2.9 Statistical Analysis

Statistical analysis was performed using GraphPad Prism 5.0.

All the values of OGTT, biochemical parameters, and body weight were expressed as Mean ± Standard Error of Mean (S.E.M.). The values were analyzed for statistical significance using one-way analysis of variance (ANOVA), followed by Dunnett's test.

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 Appearance and percentage yield of HAECMR

Colour -brownish

Consistency -semi solid

Percentage yield -10.12%

3.2 Preliminary phytochemical screening:

Table 1: Results of the preliminary phytochemical constituents present in HAECMR

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S.NO	Plant constituents	HAECMR
1	Alkaloids	+ve
2	Aminoacids	+ve
3	Proteins	+ve
4	Carbohydrates	+ve
5	Flavonoids	+ve
6	Glycosides	+ve
7	Tanins	+ve
8	Terpenoids	+ve
9	Saponins	+ve
10	Phenolic	+ve

Results:
The phytochemicals present in the hydroalcoholic extract of *Crateva magna* were amino acids, carbohydrates, flavonoids, glycosides, tannins, terpenoids, saponins, and phenolic compounds.

3.3 ACUTE TOXICITY STUDY
OCED423-Acute oral toxicity: Toxic classic method
The effect of different doses of hydro alcoholic extract of *Crateva magna* root on acute toxicity test.

Table 2: Results of the percentage mortality and signs of toxicity in different doses of HAECMR-treated groups

Group(n=3)	Treatment	Mortality at14thday	% Mortality	Signs of toxicity
1	Normal control	0/3	0	-
2	HAECMR 300mg/kg;p.o.,	0/3	0	-
3	HAECMR 2000mg/kg; p.o.,	0/3	0	-
4	HAECMR 3000mg/kg; p.o.,	0/3	0	-

Results
Administration of various doses of the hydroalcoholic extract of *Crateva magna* root (HAECMR) in rats resulted in 0% mortality and no observed signs of toxicity, even at the highest dose of 3000 mg/kg. This indicates that the extract is non-toxic at the tested doses.

3.4 Oral glucose tolerance test(ogtt)
The effect of different doses of hydroalcoholic extract of *Crateva magna* root on oral glucose tolerance test in normal rats.

Table 3: Results of effects of HAECMR on OGTT

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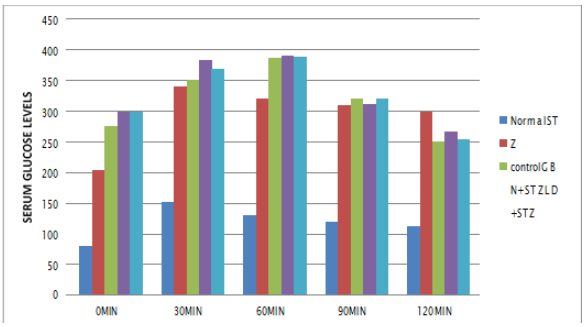
Group	Treatment	SERUMGLUCOSE(mg/ml)				
		0min	30min	60min	90min	120min
1	Normal control	80.56± 1.68	152.20±1.25	130.70±1.12	120.1±1.62	112.37±2.21
2	STZ treated diabetic control	203.71±2.52	330.21±2.51	321.43±2.77	310.44±3.63*	298.51±3.14
3	Glibenclamide(10mg/kg;p.o) +glucose(2gm/kg;p.o)	275.43±7.64	350.63±7.31	387.50±7.37	320.71±6.46	250.31±8.34
4	HAECMR(100mg/kg;p.o)+ glucose(2gm/kg;p.o)	298.86±12.31	383.56±5.08	390.5±7.13**	311.40±6.92	265.73±5.96**
5	HAECMR(300mg/kg;p.o)+ glucose(2gm/kg;p.o)	298.88±13.52	369.57±8.10	388.51±7.24	320.71±6.20**	253.31±9.82**



Graph 1: Diagramatic representation of results of the effects of HAECMR on OGTT

GLU – Glucose (2 g/kg; p.o.)
HD – High dose (300 mg/kg; p.o.) of extract
LD – Low dose (100 mg/kg; p.o.)
STZ – Streptozotocin
The OGTT results showed that the extract-treated groups experienced a dose-dependent decrease in blood glucose levels. Groups II and IV had significant glucose-lowering effects between 90–120 minutes, similar to standard diabetic treatment. These effects suggest that the extract may enhance glucose utilization, potentially due to the presence of flavonoids, terpenes, or saponins. Further research is needed to confirm the active components and mechanisms.

3.5 Estimation of biochemical parameters

A. Estimation of blood glucose

Table 4: results of the effects of HAECMR on serum glucose levels

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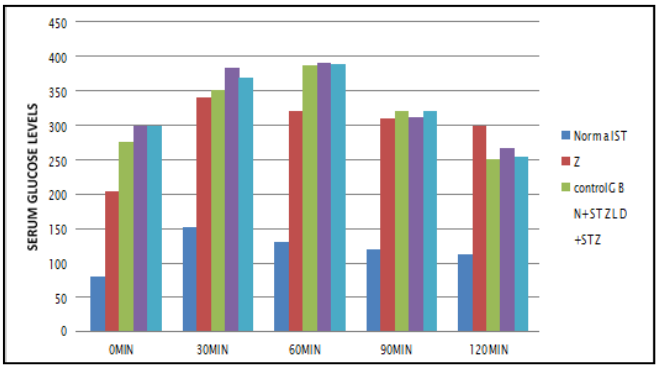
Group	Treatment	Serum glucos elevels(mg/dl)			
		0st day	7th day	14th day	21st day
1	Normal control	85.81±5.52	87.21±5.36	79.59±5.64	83.45±5.72
2	STZ treated diabetic control	195.47±6.33***	216.25±8.36***	232.21±10.299***	256.40±8.65***
3	Glibenclamide(10 mg/kg;p.o)+STZ	294.71±12.04	239.45±5.71**	206.21±7.74**	181.21±7.22**
4	HAECMR(100 mg/kg;p.o)+STZ	298.01±12.31**	258.63±7.33***	230.52±11.30**	198.20±9.63**
5	HAECMR(300 mg/kg;p.o)+STZ	298.88±13.52	235.11±5.54***	210.03±3.35**	185.71±7.84***



Graph 2: Diagramatic representation of results of the effects of the HAECMR on Serum glucose levels

Results

STZ-treated diabetic rats showed significantly elevated blood glucose levels compared to normal controls. Treatment with Glibenclamide (10 mg/kg) and HAECMR (300 mg/kg) significantly reduced glucose levels on days 7, 14, and 21, with HAECMR showing effects comparable to Glibenclamide.

B Estimation of total cholesterol

Table 5: Results of the effects of HAECMR on serum total cholesterol levels

Group	Treatment	Serum total cholesterol(mg/dl)	
		1st day	48th day
1	Normal control	71.28±5.23	72.18±7.09
2	STZ treated control	73.63±7.35	118.30±16.19
3	Glibenclamide(10mg/kg;p.o)+ STZ	68.15±3.12	93.93±10.2
4	HAECMR(100 mg/kg;p.o) + STZ	69.16±6.12	97.38±7.32
5	HAECMR(300 mg/kg;p.o) + STZ	67.79±4.14	76.7±4.78*

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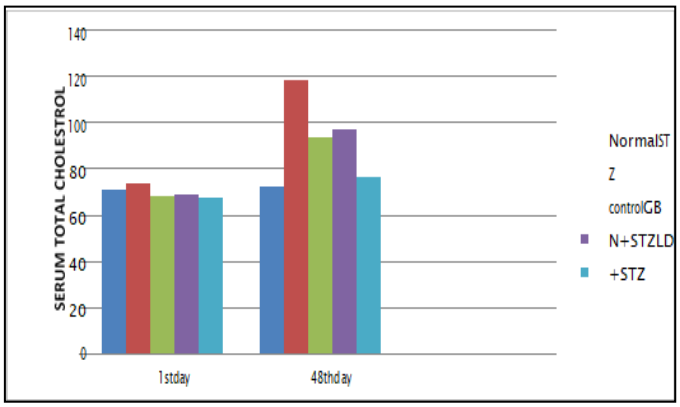


Graphn 3: Diagramatic representation of the results of the effects of the HAECMR on total cholesterol levels

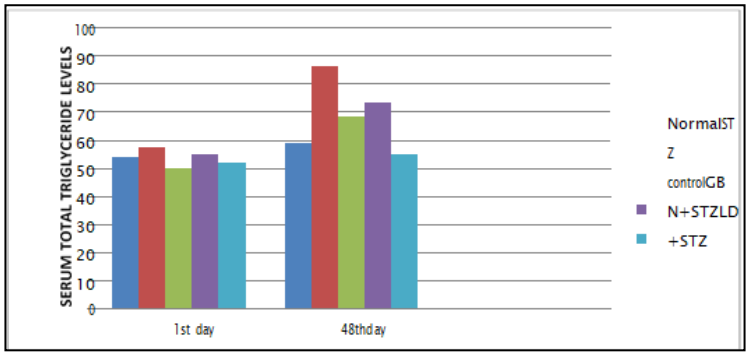
Results

When compared with the STZ-treated diabetic control group, the Glibenclamide + STZ-treated group showed a significant decrease in total cholesterol levels ($p<0.05$). Similarly, when compared with the STZ-treated diabetic control group and the Glibenclamide + STZ-treated group, the HAECMR (300 mg/kg; p.o.) group also showed a significant decrease in total cholesterol levels ($p<0.05$).

C. Estimation of triglycerides

Table 6: Results of the effects of HAECMR on serum triglyceride levels

Group	Treatment	Serum triglycerides (mg/dl)	
		1st day	48th day
1	Normal control	54.27±3.71	59.20±4.33
2	STZ treated control	57.56±3.16	86.15±2.89
3	Glibenclamide(10mg/kg;p.o) + STZ	50.09±2.81	68.39±3.98
4	HAECMR(100mg/kg;p.o)+STZ	55.12±7.1	73.29±8.0
5	HAECMR(300mg/kg;p.o)+STZ	52.33±5.12	55.2±3.41*



Graph 4: Diagramatic representation of the results of the effects of the HAECMR on TG levels

Results

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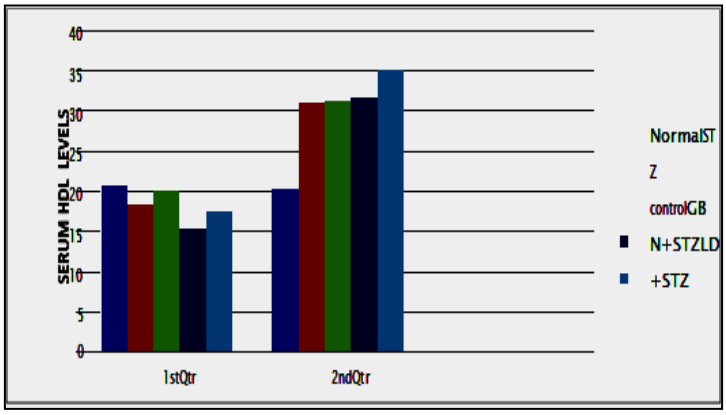
When compared with the STZ-treated diabetic control group, the Glibenclamide + STZ-treated group showed a significant decrease in serum triglyceride levels ($p<0.05$). Similarly, compared with both the STZ-treated diabetic control group and the Glibenclamide + STZ-treated group, HAECMR (300 mg/kg; p.o.) showed a significant decrease in serum triglyceride levels ($p<0.05$).

D. Estimation of HDL

Table 7: Results of the effects of HAECMR on serum HDL levels

Group	Treatment	Serum HDL(mg/dl)	
		1st day	48th day
1	Normal control	20.72±3.56	20.23±2.68
2	STZ treated control	18.49±4.16	31.01±3.51
3	Glibenclamide(10mg/kg;p.o) + STZ	20.14±3.69	31.35±2.76
4	HAECMR(100mg/kg;p.o)+STZ	15.49±4.73	31.73±2.89
5	HAECMR(300mg/kg;p.o)+STZ	17.57±3.84	35.06±3.16*



Graph 5: Diagramatic representation of results of HAECMR on HDL

Results

When compared to the STZ-treated diabetic control group and the Glibenclamide + STZ-treated group, HAECMR (300 mg/kg; p.o.) showed a significant increase in HDL levels ($p<0.05$

E. Estimation of LDL

Table 8:. Results of the effects of HAECMR on serum LDL levels

Group	Treatment	Serum LDL (mg/dl)	
		1st day	48th day
1	Normal control	39.71±5.24	40.11±3.81
2	STZ treated control	43.63±4.68	70.06±12.0
3	Glibenclamide(10mg/kg;p.o) + STZ	38.00±5.11	48.91±8.30
4	HAECMR(100mg/kg;p.o)+STZ	42.65±2.48	51.0±3.53

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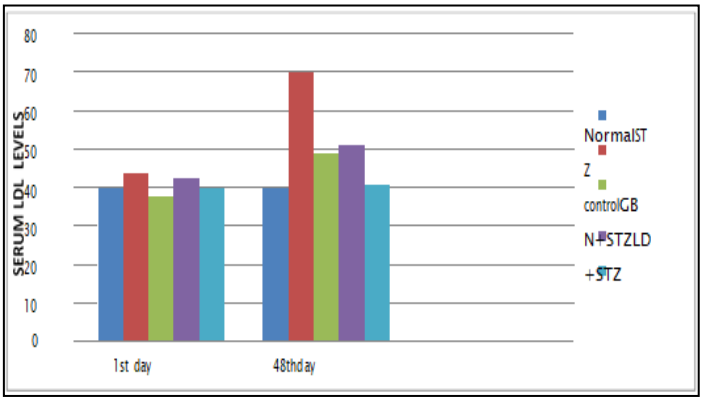
5	HAECMR(300mg/kg;p.o)+STZ	39.76±2.64	40.6±0.04*

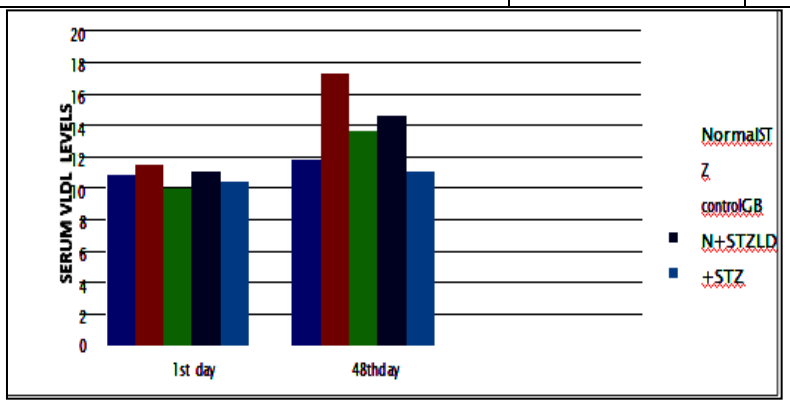


Graph 6: Diagrammatic representation of results of effects of HAECMR on LDL levels

F. Estimation of VLDL

Table 9: Results of the effects of HAECMR on serum VLDL levels

Group	Treatment	SerumVLDL(mg/dl)	
		1st day	48th day
1	Normal control	10.85±0.74	11.84±0.86
2	STZ treated control	11.51±0.63	17.23±0.57
3	Glibenclamide (10mg/kg;p.o) + STZ	10.01±0.56	13.67±0.57
4	HAECMR(100mg/kg;p.o)+STZ	11.02±1.42	14.65±1.6
5	HAECMR(300mg/kg;p.o)+STZ	10.46±1.02	11.04±0.68*



Graph 7: Diagramatic representation of results of effects of HAECMR on VLDL levels

Results

When compared to the STZ-treated diabetic control group and the Glibenclamide + STZ-treated group, HAECMR (300 mg/kg; p.o.) showed a significant decrease in VLDL levels ($p<0.05$).

G. Estimation of body weight

Table 10:. Results of the effects of HAECMR on body weight

Group	Treatment	Bodyweight(gm)

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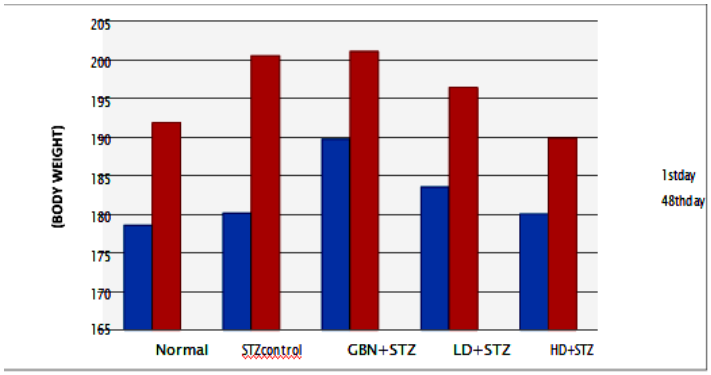
		0thday	**48thday**	**Gain**
1	Normal control	178.60±5.7	191.9±5.1	13.30±4.50
2	STZ treated control	180.19±3.32	200.57±4.13	20.38±5.0
3	Glibenclamide(60µg/kg;p.o) +STZ	189.75±5.1	201.13±5.0	11.38±4.98
4	HAECMR(100mg/kg;p.o)+ STZ	183.56±4.2	196.45±3.9	12.89±2.9
5	HAECMR(300mg/kg;p.o)+ STZ	180.10±3.9	189.9±7.05*	9.8±4.6*



Graph 8: Diagramatic representation of results of effects of HAECMR on body weight before and after treatment of standard and HAECMR

Results

When compared with the STZ-treated diabetic control group, the Glibenclamide + STZ group and HAECMR (300 mg/kg; p.o.) showed a significant difference in body weight ($p<0.05$).

Discussion

The study evaluated the antidiabetic and hypolipidemic effects of hydroalcoholic extracts of *Crateva magna* root in STZ-induced diabetic rats. The extract was found to be non-toxic up to 3000 mg/kg and contained phytochemicals such as flavonoids, terpenoids, saponins, and phenolic compounds. In the Oral Glucose Tolerance Test (OGTT), the extract significantly improved glucose tolerance and reduced blood glucose levels in a dose-dependent manner, with effects comparable to Glibenclamide.

Additionally, the extract improved lipid profiles by significantly reducing total cholesterol, triglycerides, LDL, VLDL, and increasing HDL levels by day 48. These findings suggest that *Crateva magna* root extract possesses antidiabetic and hypolipidemic properties, likely due to its bioactive constituents. Further studies are recommended to explore its mechanisms and potential clinical use.

3.6 Eugenia jambolana

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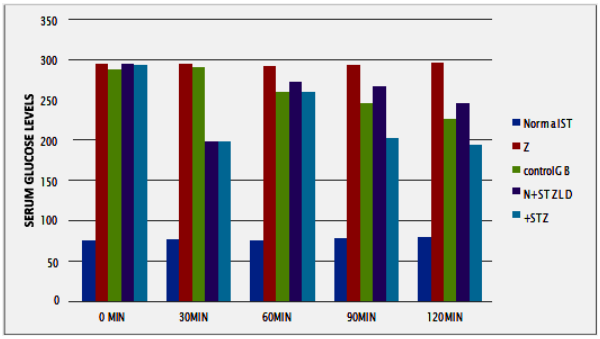
3.6.1 Oral glucose tolerance test (OGTT)

The effect of different doses of hydroalcoholic extract of *Eugenia jambolana* seed on oral glucose tolerance test in normal rats

Table 11. Results of effects of HAEEJS on OGTT

Group	Treatment	SERUM GLUCOSE(mg/ml)				
		0min	30min	60min	90min	120 min
1	Normal control	76.23±1.68	76.86±1.52	75.90±1.32	78.32±1.45	79.70± 1.27
2	STZ treated diabetic control	294.5±6.51	294.89±6.45	292.43±6.53	293.91±6.72	295.9± 6.87
3	Glibenclamide(10mg/kg;p.o) +glucose(2gm/kg;p.o)	288.3±8.21	290.43±6.56	259.50±5.92	246.32±4.54	226.31 ± 3.60
4	HAEEJS(100mg/kg;p.o)+ glucose(2gm/kg;p.o)	294.86±5.75	199.12±5.67	272.30±3.52 * *	267.45±3.79	246.53 ± 3.81
5	HAEEJS(300mg/kg;p.o)+ glucose(2gm/kg;p.o)	294.13±8.65	198.28±6.26	259.5±5.53	202.67±3.82 * *	194.81 ± 3.51

The values were estimated as Mean ± S.E.M. (n = 6). Extract-treated, Glibenclamide-treated, and glucose-treated groups were compared with the vehicle control and STZ-treated groups. P < 0.01 – statistically very significant; *P* < 0.05 – statistically significant; ns – statistically not significant.



Graph 9:Diagrammatic representation of results of the effects of HAEEJS on OGTT

Results

The OGTT results showed that *Crateva magna* extract significantly lowered blood glucose levels in a dose-dependent manner, especially between 90–120 minutes, with effects similar to standard diabetic treatment. This hypoglycemic action may be linked to phytochemicals like flavonoids, terpenes, and saponins, warranting further study.

3.6.2 Estimation of biochemical parameters

A. Estimation of blood glucose

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Table 12: Results of the effects of HAEEJS on serum glucose levels

Group	Treatment	Serum glucose levels(mg/dl)			
		0st day	7th day	14th day	21st day
1	Normal control	76.1±5.52	79.6±1.96	80.3±1.64	83.45±1.72
2	STZ treated diabetic control	294.47±6.33***	318±8.36***	372.21±10.299***	396.40±8.65***
3	Glibenclamide(10 mg/kg;p.o)+STZ	288.31±12.04	140.8±5.71**	185.1±7.74**	120.21±7.22**
4	HAEEJS(100 mg/kg;p.o)+STZ	294±5.75**	199.63± 3.63***	136.52±11.30**	123.20±9.63**
5	HAEEJS(300 mg/kg;p.o)+STZ	294±8.65	158.11±5.54***	132.03±3.35**	95.25±7.84***

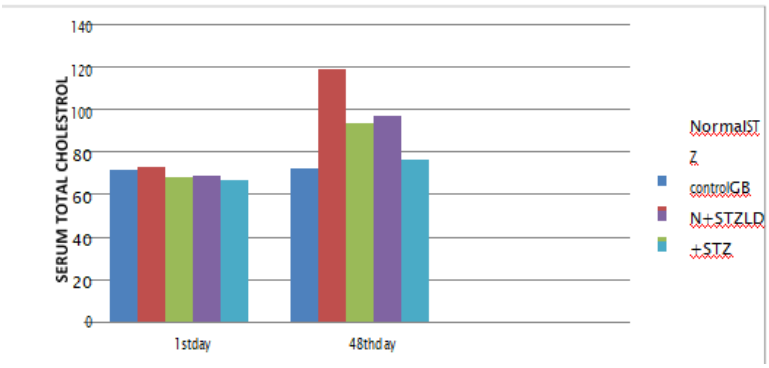
Results

Blood glucose levels were significantly higher in the STZ-treated diabetic control group compared to the normal control group. Treatment with Glibenclamide (10 mg/kg) or HAEEJS (300 mg/kg) significantly reduced blood glucose levels on the 7th, 14th, and 21st days compared to the diabetic control group.

B Estimation of total cholesterol

Table 13: Results of the effects of HAEEJS on serum total cholesterol levels

Group	Treatment	Serum total cholesterol(mg/dl)	
		1st day	48th day
1	Normal control	71.68±5.12	71.24±7.10
2	STZ treated control	73.31±6.35	118.20±16.11
3	Glibenclamide(10mg/kg;p.o)+ STZ	68.54±3.10	94.33±10.1
4	HAEEJS (100 mg/kg;p.o) + STZ	70.21±6.12	96.08±7.32
5	HAEEJS (300 mg/kg;p.o) + STZ	67.19±4.12	75.4±4.59*



Graph 10: .Diagramatic representation of the results of the effects of the HAEEJS on total cholesterol levels.

RESULTS

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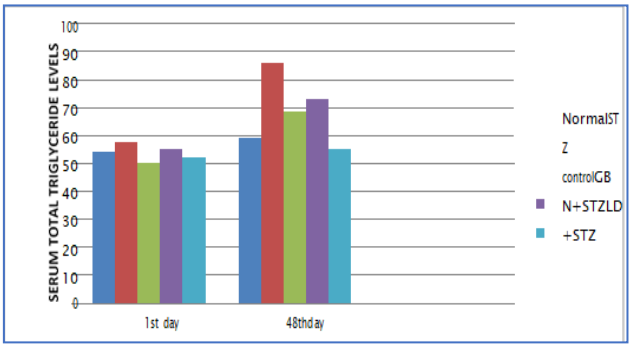
When compared with the STZ-treated diabetic control group, the Glibenclamide + STZ-treated group showed a significant decrease in total cholesterol levels ($p < 0.05$). Furthermore, when compared with both the STZ-treated diabetic control group and the Glibenclamide + STZ-treated group, the HAEEJS (300 mg/kg; p.o.) group showed a significant decrease in total cholesterol levels ($p < 0.05$).

C. Estimation of triglycerides

Table 14: Results of the effects of HAEEJS on serum triglyceride levels

Group	Treatment	Serum triglycerides (mg/dl)	
		1st day	48th day
1	Normal control	54.72±3.61	58.10±4.13
2	STZ treated control	57.57±3.13	85.51±2.29
3	Glibenclamide (10mg/kg;p.o)+ STZ	50.29±2.91	67.32±3.91
4	HAEEJS(100mg/kg;p.o)+STZ	55.02±7.2	72.91±8.01
5	HAEEJS(300mg/kg;p.o)+STZ	52.34±5.22	54.21±3.11*



Graph 11: Diagramatic representation of the results of the effects of the HAEEJS on TGl evels.

Results

When compared with the STZ-treated diabetic control group, the Glibenclamide + STZ-treated group showed a significant decrease in serum triglyceride levels ($p < 0.05$). Furthermore, when compared with both the STZ-treated diabetic control group and the Glibenclamide + STZ-treated group, the HAEEJS (300 mg/kg; p.o.) group showed a significant decrease in serum triglyceride levels ($p < 0.05$)

D. Estimation of HDL

Table 15: Results of the effects of HAEEJS on serum HDL levels

Group	Treatment	Serum HDL(mg/dl)	
		1st day	48th day
1	Normal control	20.82±3.46	20.13±2.58
2	STZ treated control	18.59±4.26	30.21±3.41
3	Glibenclamide(10mg/kg;p.o) + STZ	20.17±3.70	30.34±2.69
4	HAEEJS(100mg/kg;p.o)+STZ	15.52±4.71	30.71±2.90
5	HAEEJS(300mg/kg;p.o)+STZ	17.61±3.82	34.26±3.06*

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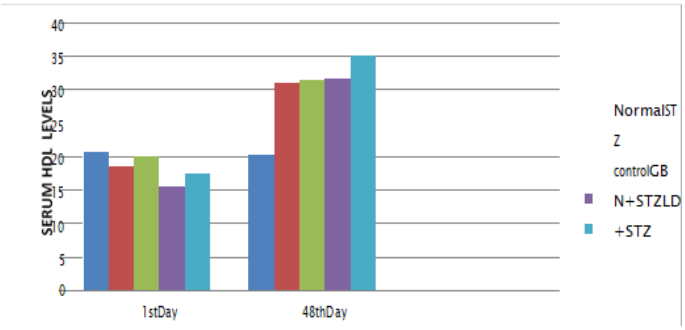


Graph 12:Diagramatic representation of results of HAEEJS on HDL

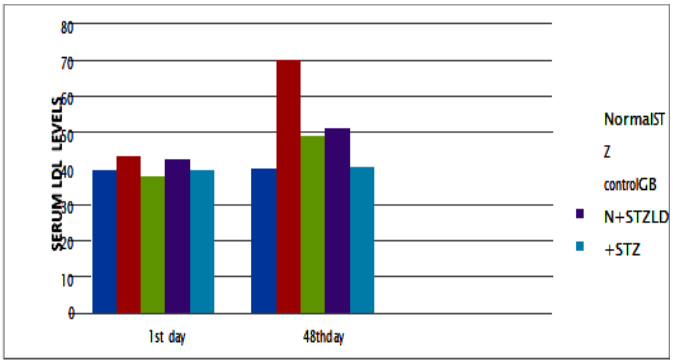
RESULTS

When compared to the STZ-treated diabetic control group and the Glibenclamide + STZ treated group, HAEEJS (300 mg/kg; p.o.) showed a significant increase in HDL levels ($p < 0.05$).

E. Estimation of LDL

Table 16: Results of the effects of HAEEJS on serum LDL levels

Group	Treatment	Serum LDL(mg/dl)	
		1st day	**48th day**
1	Normal control	39.81±5.14	40.87±3.82
2	STZ treated control	43.67±4.69	69.26±12.0
3	Glibenclamide (10mg/kg;p.o) + STZ	38.01±5.14	47.97±8.32
4	HAEEJS (100mg/kg;p.o)+STZ	42.75±2.58	50.03±3.51
5	HAEEJS (300mg/kg;p.o)+STZ	39.72±2.65	40.71±0.03*



Graph 13: Diagramatic representation of results of effects of HAEEJS **on LDL levels**

F. Estimation of VLDL

Table 17: Results of the effects of HAEEJS on serumVLDL levels

Group	Treatment	SerumVLDL(mg/dl)	
		1st day	**48th day**
1	Normal control	10.81±0.73	11.62±0.87
2	STZ treated control	11.53±0.61	16.72±0.53

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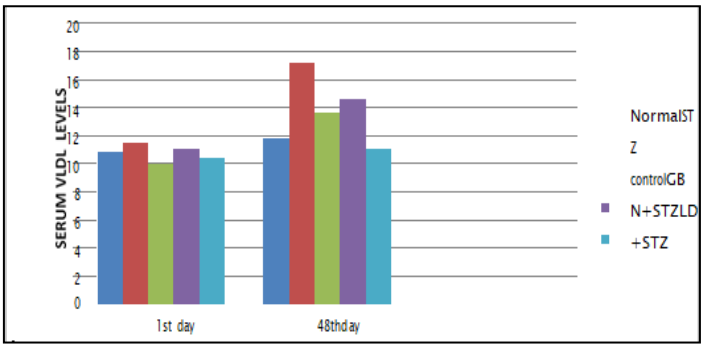
3	Glibenclamide (10mg/kg;p.o) + STZ	10.06±0.51	13.98±0.56
4	HAEEJS(100mg/kg;p.o)+STZ	11.12±1.41	13.96±1.7
5	HAEEJS(300mg/kg;p.o)+STZ	10.45±1.03	11.10±0.69*



Graph 14: Diagramatic representation of results of effects of HAEEJS on VLDL levels

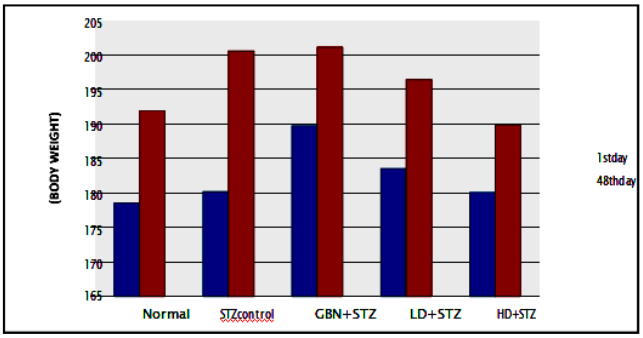
Results

When compared to the STZ-treated diabetic control group and the Glibenclamide + STZ treated group, HAEEJS (300 mg/kg; p.o.) showed a significant decrease in VLDL levels ($p < 0.05$).

G. Estimation of body weight

Table 18:Results of the effects of HAEEJS on body weight

Group	Treatment	Bodyweight(gm)		
		0^{th}day	48^{th}day	Gain
1	Normal control	178.61±5.6	190.8±5.2	12.19±4.52
2	STZ treated control	180.18±3.31	201.67±4.14	21.49±5.01
3	Glibenclamide(60µg/kg;p.o)+STZ	189.55±5.11	200.10±5.01	10.55±4.99
4	HAEEJS(100mg/kg;p.o)+STZ	183.65±4.21	195.43±3.91	11.78±2.91
5	HAEEJS(300mg/kg;p.o)+STZ	180.41±3.91	188.7*±7.07	8.29*±4.60



Graph 15: Diagramatic representation of results of effects of HAEEJS on body weight before and after treatment of standard and HAEEJS

Results

When compared with the STZ-treated diabetic control group, the Glibenclamide + STZ group and HAECMR (300 mg/kg; p.o.) showed a significant difference in body weight

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($p < 0.05$).

In addition to the above test, the percentage fall in blood glucose levels was calculated for three samples:

1. *Crateva magna*,
2. *Eugenia jambolana*, and
3. A 1:1 mixture of these two.

Table 19: *Crateva magna* root(HAECMR)

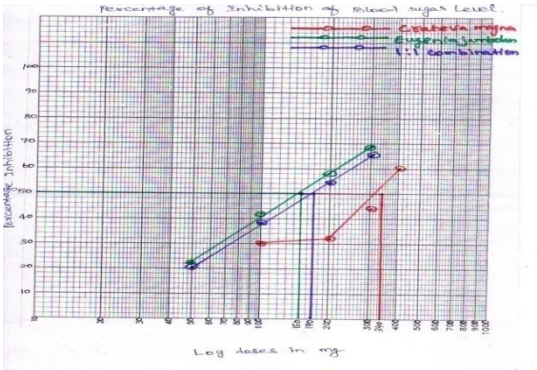
Doses inmg/kg,p.o	0Day	7thDay	14thDay	21stDay	% agefallafter21days
100	298.0±12.31**	248.63±7.33***	220.52±11.30**	185.20±9.63	30%
200	310.44±6.25	268.0±7.62**	212.0±6.85	175.40±5.92	32%
300	298.88±3.52**	235.11±5.50***	210.03±3.35**	185.71±7.84***	44%
400	298.12±5.98	210.45±6.21	188.74±4.35	119.22±6.25	60%

Table 20: Eugenia jambolana seed(HAEEJS)

Doses inmg/kg,p.o	0Day	7thDay	14thDay	21stDay	% age fall after 21 days
50	294.0±3.18	252.58±3.67	241.80±4.21	229.32±4.13	22%
100	294.0±5.12	199.0±3.63***	185.38±2.15***	170.60±4.45	42%
200	294.0±6.18	182.30±4.54	152.88±4.32	123.48±5.42	58%
300	294.0±6.78	158.0±3.84***	136.30±2.74***	95.25±3.75	68%

Table 21: *Crateva magna* and *Eugenia jambolana* 1:1combination(HAECOM)

Dosesinmg/kg,p.o	0Day	7thDay	14thDay	21stDay	%agefall after 21days
50	295.15±5.12	280.15±3.62	257.23±4.18	236.15±5.24	20%
100	294.25±4.82	280.32±5.62	249.45±3.14	182.45±4.27	38%
200	296.75±3.98	274.34±4.67	221.27±5.51	136.50±5.02	54%
300	295.65±5.08	271.67±3.82	196.78±4.64	103.48±3.14	65%



Graph 16: Dose Response Curve

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4. CONCLUSION

In conclusion, the hydroalcoholic extract of *Crateva magna* root (HAECMR), individually and in combination with *Eugenia jambolana* seed, demonstrated significant antidiabetic and hypolipidemic effects in STZ-induced diabetic rats. The extract not only improved glucose tolerance and insulin levels but also favorably modulated lipid parameters and prevented diabetes-induced weight loss. These effects were dose-dependent and comparable to the standard antidiabetic drug Glibenclamide. The study supports the traditional use of *Crateva magna* in managing diabetes mellitus and highlights its potential for development into a plant-based therapeutic agent. Further studies, including histopathological and clinical investigations, are recommended to explore its mechanism of action and confirm its safety and efficacy in humans.

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