RESEARCH ARTICLE

Protective Effects of *Artocarpus heterophyllus* (Jackfruit) Seed Extract on Haemato-Biochemical Alterations in Streptozotocin-Induced Diabetic Rats

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Abstract

The present study was conducted to evaluate the protective effects of 70% alcoholic extract of *Artocarpus heterophyllus* (jack fruit) seed on haematological and serum biochemical alterations in streptozotocin (STZ)-induced diabetic Wistar rats. Forty adult male rats were divided into five groups: normal control, vehicle control (0.5% carboxy methylcellulose), diabetic control (STZ @ 45 mg/kg b.wt. once i/p), diabetes induced-glibenclamide-treated (0.61 mg/kg b. wt.), and diabetes induced - *A. heterophyllus* seed extract-treated (500 mg/kg b.wt. orally) groups. Diabetes was induced using STZ @ 45 mg/kg body weight intraperitoneally, and treatments were administered orally for 28 days. Diabetic rats exhibited classical clinical signs including polyuria, polydipsia, polyphagia, lethargy, hyperglycemia, and significant body weight loss. Significant alterations in haematological parameters, total cholesterol, and triglyceride levels were also observed in the diabetic control group. Treatment with glibenclamide and hydroalcoholic *A. heterophyllus* seed extract significantly improved body weight, feed intake, blood glucose level, haematological indices, and lipid profile toward normal values. The beneficial effects of the plant extract may be attributed to its antihyperglycemic, antioxidant, hypolipidemic, and immunomodulatory properties associated with flavonoids, phenolic compounds, and dietary fiber. The findings suggest that *Artocarpus heterophyllus* seed extract possesses significant protective potential against diabetes-associated metabolic and haemato-biochemical alterations.

Key words: *Artocarpus heterophyllus* seeds, Haematological parameters, Hypoglycaemia, Serum lipid profiles, STZ-induced diabetic rats.

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Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, insulin resistance, or both (WHO, 2014). It affects the metabolism of carbohydrates, lipids, and proteins and presents with symptoms such as polyuria, polydipsia, polyphagia, weight loss, fatigue, and delayed wound healing (Savage *et al*., 2007). Poor glycemic control can lead to serious complications, including microvascular (nephropathy, neuropathy, retinopathy) and macrovascular (cardiovascular disease and stroke) disorders (Blonde, 2012). According to The International Diabetes Federation (IDF, 2021) globally, diabetes has emerged as a major public health challenge, with approximately 537 million adults affected in 2021, a number projected to rise significantly by 2045. DM is primarily classified into Type 1 (autoimmune destruction of pancreatic β-cells leading to insulin deficiency) and Type 2 (characterized by insulin resistance and/or impaired insulin secretion) (Mozaffari, 2013). The disease has multifactorial causes, including genetic, environmental, and lifestyle factors, as well as pancreatic and endocrine disorders. It is also commonly observed in animals such as dogs and cats (Rathod, 2017).

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Current treatment strategies include insulin therapy and oral hypoglycemic agents, which, although effective, are associated with various side effects and limitations. This has driven the search for safer and more effective alternatives. In this context, medicinal plants have gained attention due to their therapeutic potential, affordability, and fewer

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adverse effects. Traditional systems like Ayurveda have long utilized plant-based remedies for diabetes, and numerous plant species and bioactive compounds have demonstrated promising antidiabetic properties in experimental studies. *Artocarpus heterophyllus* (jackfruit), a member of the Moraceae family and commonly known as "Kathal," is a nutritionally and pharmacologically important plant. It is rich in dietary fibre, vitamins such as thiamine and ascorbic acid, and bioactive compounds including flavonoids and phenolics, which contribute to its strong antioxidant activity. Traditionally, various parts of the plant have been used in medicine and as animal fodder (Thakuria, 2017). In view of the increasing interest in plant-based therapeutics and the limited scientific evidence regarding the immunopathological effects of *Artocarpus heterophyllus* seed extract, the present study was undertaken to evaluate its potential in a Streptozotocin-induced diabetes rat model. This investigation was designed to explore the therapeutic efficacy and possible ameliorative role of *Artocarpus heterophyllus* seed extract in managing diabetes-associated alterations.

Materials and Methods

Collection of Plant Materials

Artocarpus heterophyllus was collected from market of Navsari, Gujarat (India). The plant species identification was confirmed by Department of Botany, Navsari Agricultural University, Navsari, Gujarat.

Preparation of Extract

The powder of seeds (680 gm) of *Artocarpus heterophyllus* was extracted by use of maceration method. It is a simple method of extraction and does not have the potential to damage plant active substances. Jackfruit seed powder was weighed as much as 680 gm, then it was extracted with 4 L of ethanol 70% solution, soaked for 6 h, then it was allowed to stand for 3 days protected from light accompanied by stirring which aims to flatten all the powder. The macerate was obtained and then it was evaporated using a vacuum rotary evaporator to obtain 70% ethanol extract (Ri, 2008).

Experimental Design

40 adult male Wistar rats were divided in to five groups. Each group contained eight animals. All experimental rats were acclimatized for 7 days under standard laboratory conditions prior to the commencement of the experiment. Group I served as healthy/normal control in which no treatment was given. Group II served as the vehicle control in which the 0.5% carboxymethylcellulose (CMC) was given orally. In group III, IV and V, rats were administered with streptozotocin (dissolved in chilled citrate buffer prepared with 0.1 M citric acid, pH 3.5-4.5) @ 45 mg/kg body weight intraperitonially on 1st day after acclimatization period to induce the diabetes. Blood was withdrawn from the retro-orbital plexus of rats to confirm blood glucose level using Gluco spot glucometer. After 96 h of streptozotocin injection, rats were considered as a diabetic rat with blood glucose level greater than 150 mg/dL (Diabetes control group III) and this day was considered as Day 0 of the treatment schedule. Thereafter, the experimental animals received the respective treatments for 28 days. After confirmation of diabetes, rats of group IV were treated with Glibenclamide @ 0.61 mg/kg body weight orally, while rats of group V were treated with ethanolic extract of *Artocarpus heterophyllus* seeds @ 500 mg/kg body weight orally for 28 days.

Streptozotocin (STZ), an established diabetogenic agent originating from the fungus *Streptomyces achromogenes*, is extensively used to develop type-1 diabetes in experimental rodents due to its selective cytotoxic effect on pancreatic β-cells. This targeted destruction results in diminished insulin secretion and persistent hyperglycemia.

Clinical Observations, Feed Intake and Body Weight

All animals were observed throughout the experimental period for the development of clinical and behavioural alterations. Feed intake was assessed by recording feed offered and leftover feed. Body weights were recorded at weekly intervals throughout the study period.

Collection of Blood / Serum Samples

For haematological and biochemical assessments, blood samples (1-1.5 mL) were collected from the retro-orbital plexus under light anaesthesia on the 29th day into sterile K_3EDTA vacutainers for haematological analysis and anticoagulant-free plain tubes for serum biochemical examinations. The blood in plain vials was allowed to clot naturally. Serum was obtained by centrifugation at 11,180 x g for 10 min and stored at –20°C until analysed.

Haematological evaluation was performed using an automated haematology analyser (Exigo EOS Vet, Sweden). The parameters assessed included haemoglobin, packed cell volume, total erythrocyte count including erythrocyte indices, total leukocyte count, differential leukocyte count and platelet count. Serum biochemical parameters were estimated using standard assay kits with an automatic biochemistry analyser (Micro lab RX-50V) and included total cholesterol and triglyceride.

Blood glucose estimation was performed before streptozotocin (STZ) administration (baseline) and 96 hours after STZ administration to confirm diabetes induction. Thereafter, blood glucose levels were measured using a Gluco Spot glucometer on days 0, 8th, 15th, 22nd, and 29th of the treatment period with a small blood sample collected from the tail vein.

Statistical Analysis

Body weight, feed intake, blood glucose level, haematological parameters, and biochemical parameters were analyzed statistically using SPSS software version (IBM SPSS statistics 27). One-way ANOVA followed by Duncan's multiple range

test was applied in all parameters to evaluate differences among the groups. A probability value of $p \leq 0.05$ was considered statistically significant. Results were expressed as mean ± standard error.

Results and Discussion

Clinical Manifestations

Throughout the experimental period, diabetic rats exhibited classical signs following streptozotocin induction, including hyperglycemia, glycosuria, polyuria, polydipsia, polyphagia, lethargy, and progressive weight loss without mortality. As the condition advanced, additional features such as dehydration and poor hair coat quality were observed, likely due to insulin deficiency and associated metabolic disturbances. The diabetic control group III showed severe manifestations, including persistent polyuria and continuous weight loss, attributed to osmotic diuresis and enhanced proteolysis and lipolysis. In contrast, treatment groups receiving *Artocarpus heterophyllus* seed extract (Gr-V) and glibenclamide (Gr-IV) showed marked improvement in clinical signs, with reduced polyuria and polydipsia and gradual normalization of behaviour. These effects may be linked to the antihyperglycemic and antioxidant properties of bioactive compounds such as flavonoids and phenolics. The standard drug, glibenclamide, likely exerted its effect through stimulation of residual pancreatic β-cells and increased insulin secretion. Normal and vehicle control groups remained free from any clinical abnormalities throughout the study. The present findings are consistent with the AAHA (2018) guidelines and with previous reports describing weight loss, polyuria, polydipsia, increased feed intake, and lethargy as characteristic manifestations of STZ-induced diabetes due to insulin deficiency and impaired energy utilization (Akbarzadeh *et al*., 2007; Yang *et al*., 2023). Treatment with glibenclamide and 70% alcoholic *Artocarpus heterophyllus* seed extract improved these clinical signs, possibly through better glycemic control, improved metabolic regulation, and reduction of diabetes-associated catabolic changes, indicating the antidiabetic potential of the plant extract.

Feed Intake

The mean weekly values presented in the Table 1 indicate clear variations among the experimental groups over the four-week study period. The NC and VC groups maintained relatively stable and gradually increasing values from the 1st to the 4th week, with no marked fluctuations, indicating normal physiological status. In contrast, the DC group exhibited markedly higher values in the 1st and 2nd weeks compared to NC and VC groups, reaching a peak in the 2nd week (226.88 ± 16.55 g), followed by a gradual decline in the 3rd and 4th weeks; however, the values remained higher than those of the normal groups. The ST group (diabetic rats treated with Glibenclamide) showed elevated values during the 1st and 2nd weeks compared to the NC and VC groups, but a progressive reduction was observed from the 3rd week onward, reaching near-normal levels by the 4th week (167.50 ± 8.29 g). Similarly, the TT group (diabetic rats treated with 70% alcoholic *Artocarpus heterophyllus* seed extract) demonstrated higher values in the initial two weeks, followed by a gradual decline in the 3rd (183.75 ± 11.13 g) and 4th weeks (174.75 ± 8.92 g), indicating improvement with treatment. By the end of the 4th week, both ST and TT groups exhibited values closer to those of the NC and VC groups compared to the DC group. Overall, STZ-induced diabetic rats showed elevated levels during the early weeks, while treatment with glibenclamide and 70% alcoholic *Artocarpus heterophyllus* seed extract resulted in progressive improvement over time. These findings were in agreement with previous studies reporting significantly increased food intake in STZ-induced diabetic rats due to insulin deficiency–induced polyphagia and impaired glucose utilization (Tang *et al*., 2022). Treatment with glibenclamide and alcoholic *Artocarpus heterophyllus* seed extract significantly decreased the elevated food intake, with values approaching near-normal levels by the fourth week. Similar observations were reported by Goswami *et al*. (2021) and Alam *et al*. (2025), who demonstrated that jackfruit seed supplementation significantly reduced feed intake and improved metabolic regulation in high-sugar diet-fed animals.

Table 1: Average feed consumption (g/week/rat) of experimental animals of different groups (Mean ± SE)

Period	Group 1 (NC)	Group 2 (VC)	Group 3 (DC)	Group 4 (ST)	Group 5 (TT)
1st week	151.25^{b} ±8.06	153.13^{b} ±9.35	201.88^{a} ±13.39	186.88^{a} ±11.22	193.13^{a} ±11.88
2nd week	158.75^{b} ±8.90	160.38^{b} ±10.36	226.88^{a} ±16.55	198.75^{a} ±13.22	209.38^{a} ±14.06
3rd week	163.75^{b} ±8.90	166.50^{b} ±9.78	208.75^{a} ±13.65	176.25^{ab} ±9.90	183.75^{ab} ±11.13
4th Week	169.38^{b} ±9.28	172.25^{b} ±10.09	203.75^{a} ±7.35	167.50^{b} ±8.29	174.75^{b} ±8.92

Group 1: Normal nondiabetic control (NC), Group 2: Vehicle control (VC), Group 3: Streptozotocin (STZ) Induced diabetic rats (Diabetic Control -DC), Group 4: Diabetic rats treated with Glibenclamide @ 0.61 mg/kg *per os* (Standard Treatment -ST), Group 5: Diabetic rats treated with 70% alcoholic *Artocarpus heterophyllus* seed extract @ 500 mg/kg *per os* (Test treatment -TT).
Means bearing different superscripts between group differ significantly ($p<0.05$).

Body Weight

The mean body weight of experimental rats in different groups over the 28-day study period is presented in Table 2. At day 0, the body weights of all groups were comparable with no significant variation ($p>0.05$). In the normal control (NC) and vehicle control (VC) groups, a gradual and consistent increase in body weight was observed throughout the experimental period, reaching 387.73 ± 29.43 g and 389.44 ± 20.28 g, respectively, on day 28. In contrast, the diabetic control (DC) group showed a progressive decline in body weight from 239.89 ± 12.37 g on day 0 to 191.28 ± 11.39 g on day 28, which was significantly lower than the NC and VC groups ($p<0.05$). Treatment with glibenclamide (ST) resulted in a gradual improvement in body weight from 248.89 ± 12.06 g at day 0 to 351.86 ± 15.75 g on day 28, indicating significant recovery compared to the DC group ($p<0.05$). Similarly, rats treated with 70% alcoholic *Artocarpus heterophyllus* seed extract (TT) showed progressive weight gain from 231.26 ± 27.07 g on day 0 to 331.13 ± 27.60 g on day 28 which was significantly higher than the DC group ($p<0.05$) and comparable to the ST group. Overall, STZ-induced diabetic rats exhibited significant body weight loss, while treatment with glibenclamide and the plant extract effectively improved body weight, demonstrating their beneficial effect in mitigating diabetes-associated weight reduction. The present findings were consistent with earlier reports demonstrating significant body weight loss in STZ-induced diabetic rats due to insulin deficiency and enhanced catabolic activity (Mestry *et al*., 2017; Uyar and Abdulrahman, 2020; Syed *et al*., 2025; Elsharkawy *et al*., 2025), while Goswami *et al*. (2021) and Alam *et al*. (2025) showed that jackfruit seed supplementation modulated metabolic alterations and prevented excessive weight changes. Overall, the present study confirms that body weight is a sensitive indicator of metabolic impairment and therapeutic response in experimental diabetes.

Blood Glucose Level

The mean blood glucose levels (mg/dL) in rats of different experimental groups showed significant variations throughout the study period. On day 0, the NC and VC groups exhibited normal glucose levels (102.50 ± 5.79 mg/dL and 105.75 ± 5.71 mg/dL), while the DC, ST and TT groups showed significantly higher glucose values (368.38 ± 21.29, 358.50 ± 24.14 mg/dL and 490.63 ± 49.26 mg/dL, confirming successful induction of diabetes. As opined by Lenzen (2008), STZ gains entry into β-cells via glucose transporter-2 (GLUT2), where it alkylates DNA, leading to activation of poly (ADP-ribose) polymerase (PARP), depletion of intracellular NAD^+ and ATP reserves, and enhanced production of nitric oxide (NO) and reactive oxygen species (ROS). This sequence of cytotoxic events ultimately results in β-cell necrosis, culminating in insulin deficiency and the onset of insulin-dependent diabetes mellitus (IDDM). During the experimental period, the NC and VC groups maintained non-significant variations and remained within the normal range at all time intervals. In contrast, the DC group showed a significantly higher and progressively increased blood glucose level from day 8 to day 22 and remained significantly elevated at day 29, indicating persistent hyperglycemia. The ST group demonstrated a significantly lower glucose level from day 8 onward compared to the DC group, with values approaching near normal by day 29. Similarly, the TT group exhibited a significant reduction in glucose levels from day 8 to day 29 compared to the diabetic control, although the values remained significantly higher than those of the NC and VC groups at certain intervals. Overall, treatment groups showed a significant improvement in glycemic status compared to the diabetic control, while the NC and VC groups showed non-significant changes throughout the study. These findings were consistent with earlier reports demonstrating significant hyperglycemia in STZ-induced diabetic rats and marked reduction in blood glucose levels following treatment with glibenclamide and *Artocarpus heterophyllus* seed extract (Mestry *et al*., 2017; Tang *et al*., 2022; Rehman *et al*., 2023), while Chandrika *et al*. (2006), Ajiboye *et al*. (2017), Goswami *et al*. (2021), and Alam *et al*. (2025) documented significant antihyperglycemic effects of jackfruit-based interventions. The observed improvement in the present study may be attributed to enhanced insulin activity, better peripheral glucose utilization, and protective effects of the herbal extract on pancreatic β-cells.

Haemato-Biochemical Parameters

The mean ± SE values of haematological alterations are presented in Table 4. Haemoglobin, platelet count, monocyte, eosinophil, and basophil percentages did not differ significantly among the experimental groups. STZ-induced diabetic rats showed a highly significant decrease ($p<0.01$) in haematocrit,

Table 2: Average weekly body weight (g) in experimental animals of different groups (Mean ± SE)

Period	Group 1 (NC)	Group 2 (VC)	Group 3 (DC)	Group 4 (ST)	Group 5 (TT)
Day 0	260.69^{a} ±31.88	251.28^{a} ±23.95	239.89^{a} ±12.37	248.89^{a} ±12.06	231.26^{a} ±27.07
Day 7	297.39^{a} ±30.56	287.84^{a} ±23.09	218.41^{ab}±9.02	247.34^{b} ±15.69	240.01^{ab}±25.06
Day 14	330.10^{a} ±26.96	315.83^{ab} ±19.12	200.00^{c} ±9.62	278.05^{ab} ±15.05	261.43^{b} ±26.36
Day 21	361.84^{a} ±28.93	351.70^{ab}±19.95	194.35^{c} ±10.15	306.54^{ab} ±16.16	288.61^{b} ±25.38
Day 28	387.73^{a} ±29.43	389.44^{a} ±20.28	191.28^{b} ±11.39	351.86^{a} ±15.75	331.13^{a} ±27.60

Means bearing different superscripts between group differ significantly ($p<0.05$).

total erythrocyte count and total leucocyte count values compared to the NC and VC groups, while haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration exhibited non-significant alterations ($p>0.05$). Diabetes mellitus patients may also be attributed to damage in the synthesis of erythropoietin, hormone whose function in promoting formation of the red blood cells, probably due to excess blood glucose. This was coupled with non-significant ($p>0.05$) decrease in MCV, MCHC and MCH. Treatment with glibenclamide and 70% alcoholic *Artocarpus heterophyllus* seed extract significantly improved haematocrit, TEC, TLC, MCV, MCH and MCHC values toward normal levels, whereas other haematological parameters remained statistically comparable among the treated and control groups.

STZ-induced diabetic rats showed a significant decrease ($p<0.05$) in lymphocyte percentage and a significant increase ($p<0.05$) in neutrophils percentage compared to NC and VC groups, while eosinophil, monocyte and basophil percentages showed non-significant alterations ($p>0.05$). Treatment with glibenclamide and 70% alcoholic *Artocarpus heterophyllus* seed extract improved lymphocyte and neutrophils percentage toward normal values, whereas the remaining differential leukocyte counts remained statistically comparable among all experimental groups. The present findings were partially consistent with earlier studies reporting haematological alterations in diabetic conditions. Diabetes-induced reductions in lymphocyte count, TEC, PCV, and TLC may be attributed to persistent hyperglycemia, glycosylation of haemoglobin, impaired erythropoietin synthesis, oxidative stress, and reduced immune cell efficiency. Similar alterations were reported by Rehman *et al*. (2023) and Elsharkawy *et al*. (2025). Treatment with glibenclamide and 70% alcoholic *Artocarpus heterophyllus* seed extract improved these haematological parameters and normalized lymphocyte levels, possibly due to improved glycemic control and antioxidant activity of the plant extract, supporting its potential immunomodulatory and protective effects as also reported by Okonkwo *et al*. (2015) and Ajiboye *et al*. (2018).

Table 3: Effect of daily oral administration of 70% alcoholic extract of *Artocarpus heterophyllus* seed (500 mg/kg b.wt.) on blood glucose (mg/dL) level on different day of experiment in diabetic rats (Mean ± SE)

Period	Group 1 (NC)	Group 2 (VC)	Group 3 (DC)	Group 4 (ST)	Group 5 (TT)
Initial	$100.13^{a} \pm 5.99$	$108.00^{a} \pm 5.37$	$98.25^{a} \pm 3.75$	$102.25^{a} \pm 2.02$	$104.75^{a} \pm 3.83$
Day 0	$102.50^{c} \pm 5.79$	$105.75^{c} \pm 5.71$	$239.89^{a} \pm 12.37$	$358.50^{b} \pm 24.14$	$490.63^{a} \pm 49.26$
Day 8	$100.88^{c} \pm 4.69$	$108.75^{c} \pm 4.79$	$372.88^{a} \pm 42.37$	$284.13^{b} \pm 22.46$	$416.00^{a} \pm 47.81$
Day 15	$104.13^{d} \pm 3.41$	$105.25^{d} \pm 3.85$	$443.38^{a} \pm 42.05$	$231.00^{c} \pm 13.23$	$310.88^{b} \pm 27.86$
Day 22	$102.88^{d} \pm 3.08$	$104.75^{d} \pm 3.34$	$479.63^{a} \pm 16.15$	$182.38^{c} \pm 8.21$	$232.13^{b} \pm 10.58$
Day 29	$106.13^{c} \pm 3.95$	$104.88^{c} \pm 3.35$	$456.63^{a} \pm 25.12$	$108.88^{c} \pm 4.02$	$155.13^{b} \pm 6.93$

Means bearing different superscripts between group differ significantly ($p<0.05$).

Table 4: Effect of daily oral administration of 70% alcoholic extract of *Artocarpus heterophyllus* seed (500 mg/kg b.wt.) on mean values of haemato-biochemical parameters in diabetic rats at day 29th (Mean ± SE)

	Treatment groups				
Parameters	Group 1 (NC)	Group 2 (VC)	Group 3 (DC)	Group 4 (ST)	Group 5 (TT)
Hb (g/dL)	$14.10^{a} \pm 0.46$	$13.28^{a} \pm 0.50$	$13.49^{a} \pm 0.65$	$13.34^{a} \pm 0.44$	$13.43^{a} \pm 0.34$
PCV (%)	$34.57^{a} \pm 2.29$	$33.12^{a} \pm 2.22$	$22.66^{b} \pm 0.65$	$33.52^{a} \pm 1.36$	$35.69^{a} \pm 1.41$
TEC ($\times 10^{6}$/µL)	$5.59^{a} \pm 0.45$	$5.56^{a} \pm 0.46$	$3.54^{b} \pm 0.25$	$5.45^{a} \pm 0.24$	$5.47^{a} \pm 0.28$
TLC ($\times 10^{3}$/µL)	$9.45^{a} \pm 0.65$	$9.64^{a} \pm 0.77$	$5.24^{b} \pm 0.43$	$10.84^{a} \pm 0.51$	$11.26^{a} \pm 0.60$
MCV (fL)	$55.65^{b} \pm 1.88$	$57.58^{ab} \pm 3.08$	$47.43^{b} \pm 1.07$	$57.65^{ab} \pm 4.96$	$66.85^{a} \pm 4.01$
MCHC (%)	$50.70^{a} \pm 3.14$	$52.54^{a} \pm 3.07$	$53.05^{a} \pm 2.85$	$55.84^{a} \pm 2.21$	$56.86^{a} \pm 1.74$
MCH (pg)	$21.04^{bc} \pm 0.97$	$22.74^{ab} \pm 0.82$	$19.41^{c} \pm 1.40$	$24.74^{a} \pm 0.94$	$24.91^{a} \pm 0.87$
Platelet count ($\times 10^{5}$/µL)	$5.76^{a} \pm 0.29$	$5.50^{a} \pm 0.29$	$5.81^{a} \pm 0.28$	$5.38^{a} \pm 0.32$	$5.26^{a} \pm 0.28$
Lymphocytes (%)	$68.88^{a} \pm 1.69$	$65.63^{ab} \pm 1.36$	$58.50^{c} \pm 1.20$	$64.38^{b} \pm 1.31$	$65.13^{ab} \pm 1.26$
Neutrophils (%)	$29.25^{b} \pm 1.57$	$32.50^{b} \pm 1.65$	$39.63^{a} \pm 1.56$	$33.63^{b} \pm 1.36$	$33.00^{b} \pm 1.04$
Eosinophils (%)	$1.00^{a} \pm 0.42$	$0.88^{a} \pm 0.52$	$1.00^{a} \pm 0.42$	$1.00^{a} \pm 0.57$	$0.88^{a} \pm 0.44$
Monocytes (%)	$0.38^{a} \pm 0.18$	$0.50^{a} \pm 0.19$	$0.50^{a} \pm 0.19$	$0.50^{a} \pm 0.19$	$0.50^{a} \pm 0.19$
Basophils (%)	$0.50^{a} \pm 0.19$	$0.50^{a} \pm 0.19$	$0.38^{a} \pm 0.18$	$0.50^{a} \pm 0.19$	$0.50^{a} \pm 0.19$
Serum TC (mg/dL)	$34.53^{bc} \pm 2.35$	$32.33^{c} \pm 2.377$	$64.50^{a} \pm 1.301$	33.86^{bc} 2.55	$39.70^{b} \pm 2.49$
Triglycerides(mg/dL)	$159.56^{b} \pm 3.13$	$166.68^{b} \pm 3.10$	$249.72^{a} \pm 3.04$	$166.97^{b} \pm 2.74$	$168.30^{b} \pm 3.04$

Means bearing different superscripts between group differ significantly ($p<0.05$). TC - Total cholesterol.

Among the serum biochemical parameters (Table 4), the total cholesterol (TC) and triglycerides (TG) levels were markedly higher in the DC group when compared with NC and VC groups, and the difference was highly significant ($p<0.01$). Treatment with glibenclamide (ST) and plant extract (TT) resulted in a decrease in TC and TG levels when compared with the DC group; this reduction was statistically significant in the ST group and TT group. The ST group showed values comparable with NC and VC groups, indicating a non-significant difference ($p>0.05$). However, the TT group exhibited slightly higher TC levels than NC and VC groups, though the difference was non-significant ($p>0.05$). Comparison between ST and TT groups revealed lower TC levels in the ST group, but the variation was non-significant ($p>0.05$). The present study demonstrated significant hypercholesterolemia and hypertriglyceridemia in STZ-induced diabetic rats, which may be attributed to insulin deficiency-induced dyslipidaemia, enhanced mobilization of free fatty acids from adipose tissue (Mestry *et al*., 2017; Uyar and Abdulrahman, 2020; Tang *et al*., 2022; Syed *et al*., 2025), and increased LDL-cholesterol production. Treatment with glibenclamide and *Artocarpus heterophyllus* seed extract significantly reduced elevated lipid levels, possibly through improvement of insulin activity, enhanced lipid metabolism, reducing intestinal lipid absorption, reduction of plasma cholesterol and promoting bile acid excretion through the action of flavonoids, phenolic compounds, and soluble dietary fiber present in the extract. These findings were consistent with previous studies (Osmani *et al*., 2009; Omar *et al*., 2011; Mestry *et al*., 2017; Goswami *et al*., 2021; Ibrahim *et al*., 2022), supporting the hypolipidemic and potential cardioprotective effects of jackfruit-based interventions in diabetic conditions.

Conclusion

The present study demonstrated that streptozotocin-induced diabetes in Wistar rats produced marked clinical, haematological, and biochemical alterations characterized by hyperglycemia, polyphagia, polydipsia, weight loss, dyslipidaemia, and changes in haematological parameters. Treatment with 70% alcoholic extract of *Artocarpus heterophyllus* seed significantly ameliorated these diabetes-associated alterations, as evidenced by improvement in body weight, feed intake, blood glucose level, lipid profile, and haematological indices. The therapeutic effects of the extract may be attributed to its antihyperglycemic, antioxidant, hypolipidemic, and possible immunomodulatory properties mediated by flavonoids, phenolic compounds, and dietary fiber constituents. Although glibenclamide exhibited comparatively stronger effects in certain parameters, the plant extract showed considerable protective and restorative potential against STZ-induced diabetic changes. Overall, the findings suggest that *Artocarpus heterophyllus* seed extract may serve as a promising natural therapeutic agent for the management of diabetes mellitus and its associated complications.

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