International Journal of Pharmaceutical and Bio-Medical Science

ISSN(print): 2767-827X, ISSN(online): 2767-830X

Volume 06 Issue 03 March 2026

Page No : 856-862

DOI: https://doi.org/10.47191/ijpbms/v6-i3-12, Impact Factor: 8.428

Quercetin and *Gongronema Latifolium Improved* Hematological Parameters, Lipid Profile and Blood Glucose Levels in Diabetic Male Wistar Rats

Godspower Onyeso[1], Bright l. Owhorji[2]

[1,2]Department of Human Physiology, College of Medical Sciences, Rivers State University.

ABSTRACT

Diabetes mellitus is a major chronic metabolic disorder characterised by persistent hyperglycaemia and associated disturbances in lipid metabolism and blood indices that increase morbidity and mortality. Although standard therapies exist, cost, side effects, and limited access have increased interest in evidence-based plant-derived adjuncts with antihyperglycaemic and cardioprotective potential. This study evaluated the effects of quercetin and graded doses of *Gongronema latifolium* on fasting blood glucose (FBG), lipid profile, and haematological indices in alloxan-induced diabetic male Wistar rats. Using a randomised controlled experimental design, fifty-five rats were procured and acclimatised; diabetic rats meeting inclusion criteria were allocated into six groups (n = 6/group): normal control, diabetic control, diabetic + quercetin (50 mg/kg/day), and diabetic + *G. latifolium* (250, 500, and 1000 mg/kg/day), treated orally for 4 weeks. Data were analysed as mean ± SD using one-way ANOVA with Tukey post hoc test ($p < 0.05$). Alloxan induction produced significant hyperglycaemia, dyslipidaemia and inflammatory changes. FBG differed significantly across groups at week 2 ($F = 3.710$, $p = 0.049$) and week 6 ($F = 13.452$, $p = 0.001$); by week 6, *G. latifolium* reduced FBG dose-dependently (low: 126.00 ± 14.10; medium: 123.00 ± 1.00; high: 111.50 ± 0.71 mg/dL) compared with the diabetic group (185.00 ± 9.89 mg/dL), approaching the control (101.67 ± 4.16 mg/dL). Triglycerides ($p = 0.025$) and VLDL ($p = 0.036$) were significantly elevated in diabetic rats (TG 1.42 ± 0.00; VLDL 0.65 ± 0.00 mmol/L) and improved with treatment. WBC showed significant group differences ($F = 7.740$, $p = 0.006$), with diabetic leukocytosis (11.70 ± 0.00) reduced toward control (4.50 ± 0.20). Among red cell indices, only MCV differed significantly ($F = 6.478$, $p = 0.011$). In conclusion, quercetin and *G. latifolium* improved glycaemic control and key cardiometabolic/inflammatory markers in diabetic rats, with stronger effects at medium–high extract doses. Further studies should assess oxidative stress markers, organ histopathology, and combination/synergy dosing to guide translational use.

ARTICLE DETAILS

Published On:
21 March 2026

KEYWORDS: Diabetes mellitus; Alloxan; *Gongronema latifolium*; Quercetin; Lipid profile; Haematological parameters

Available on:
https://ijpbms.com/

1. INTRODUCTION

Diabetes mellitus is one of the world's most common and severe long-term metabolic disorders, characterised by hyperglycaemia of long duration resulting from insulin secretion, insulin action, or both to meet the body's needs (American Diabetes Association [ADA], 2023). In both developed and underdeveloped countries, the diabetes burden is rising, making it a critical issue that affects public health and has important implications for the well-being and functional lives of individuals (International Diabetes Federation [IDF], 2021). Carbohydrate problems aside, diabetes affects lipid metabolism and blood, leading to serious bodily dysfunctions (Akinmoladum et al., 2021).

To understand the mechanism of the disease or to test for any possible intervention, diabetic models, such as male Wistar rats, are used, where they induce diabetes using alloxan or streptozotocin (Lenzen, 2017). The models exhibit characteristics of the metabolic disorder and can be used to test various therapeutic interventions, including natural compounds, for the control of the disease.

Phytochemicals have attracted attention for their potential as anti-diabetic and cardioprotective agents. Quercetin is a bioflavonoid found in various fruits, vegetables, and plants, with a promising future as an anti-diabetic agent. Some studies have investigated the antioxidant and anti-inflammatory activities of quercetin, its effects on carbohydrate-hydrolysing enzymes, and its capacity to influence insulin sensitivity (Li et al., 2016). Additionally, quercetin has shown potential to improve lipid and blood chemistry, offering a multitude of potential advantages (Ojo et al., 2022).

A tropical medicinal plant, *Gongronema latifolium*, locally known as utazi in Nigeria, has been used to manage diabetes, high blood pressure, and abnormal lipid levels. The phytochemical constituents of utazi, such as saponins, alkaloids, flavonoids, and tannins, may be responsible for managing or lowering diabetes, combating oxidative stress, or protecting blood cells, respectively (Nwachukwu et al., 2021). Herbal practice, as well as early scientific observations, offer prospects for the management of abnormal glucose levels, abnormal lipid levels, and haematological conditions in diabetes patients (Analike et al., 2025).

Today, diabetes treatment relies heavily on medication and lifestyle changes. However, it has faced many challenges, including financial barriers, the need for lifelong treatment, and side effects, especially in rural areas (Chaudhury et al., 2017). This has made people resort to herbal medicine, but today, most herbal medicines used in the treatment of diabetes remain poorly scientifically researched.

While more studies are emerging to support quercetin and *Gongronema latifolium* separately, few have investigated how the two compounds act together in diabetic models to determine their effects on blood glucose levels, lipid profile, and haematological parameters. Such compounds are important to note as diabetic complications such as dyslipidaemia, anaemia, and oxidative stress have been identified as key causes of morbidity and mortality globally (Akinmoladun et al., 2021).

Therefore, this study sought to examine the effects of quercetin and Gongronema latifolium on haematological indices, blood glucose levels, and lipid profiles in diabetic male Wistar rats.

2. MATERIALS AND METHODS

2.1 Experimental Animals

A total of fifty-five healthy male Wistar rats weighing 150–200 g were obtained from the Animal House. Animals were housed in well-ventilated plastic cages under standard laboratory conditions (12-hour light/dark cycle, temperature 22 ± 2°C, relative humidity 50–60%) and provided standard rat pellets and water ad libitum. Rats were acclimatised for 2 weeks before the experiment began.

2.2 Study Design and Grouping

A randomised, controlled experimental design was adopted using an alloxan-induced diabetic rat model. Following diabetes confirmation, rats were randomly assigned to treatment groups (n = 6 per group) as follows:

- Normal control (NC): non-diabetic rats administered distilled water/vehicle only
- Diabetic control (DC): alloxan-induced diabetic rats administered vehicle only
- Diabetic + quercetin (DQ): alloxan-induced diabetic rats treated with quercetin (50 mg/kg/day)
- Diabetic + *G. latifolium* (250 mg/kg): alloxan-induced diabetic rats treated with extract (250 mg/kg/day)
- Diabetic + *G. latifolium* (500 mg/kg): alloxan-induced diabetic rats treated with extract (500 mg/kg/day)
- Diabetic + *G. latifolium* (1000 mg/kg): alloxan-induced diabetic rats treated with extract (1000 mg/kg/day)

The sample size was determined based on previous studies in alloxan-induced diabetic models (Niu et al., 2021; Okwu et al., 2020). All interventions were administered daily for four weeks, a duration considered sufficient to detect meaningful biochemical and functional changes (Kobori et al., 2019).

2.3 Preparation of Treatments

Analytical-grade quercetin was purchased from a reputable drugstore and formulated in 0.5% carboxymethylcellulose to deliver a dose of 50 mg/kg/day. Fresh *G. latifolium* leaves were picked from farms around Port Harcourt. The botany department confirmed the botanical identification of the sample used, and specimens were retained for future use. The leaves were cleaned, dried at room temperature, and powdered. After this, the powdered material was extracted with ethanol/methanol using a Soxhlet apparatus. The filtrate obtained in the process was dried using a rotary evaporator and stored at 4°C in an air-tight container.

2.4 Induction of Diabetes and Method of Administration

After an overnight fast, diabetes was chemically triggered in the rats. Subsequently, a single intraperitoneal injection of alloxan monohydrate was administered to the rats at a dose of 150 mg/kg body weight. This was done in normal saline solution. To protect against hypoglycaemia, rats received a 5% glucose solution for 24 hours. After 3 days, progression towards diabetes was assessed by measuring fasting blood glucose levels. Those with levels of 200mg/dL or higher were selected as diabetic rats.

The treatment regimens were initiated 72 hours after alloxan administration. Quercetin extracts of *G. latifolium* were administered orally by the gavage method. The method helps ensure dose control (Kobori et al., 2019; Okwu et al., 2020). During the 28-day study period, the animals were monitored for appetite, weight changes, and any adverse reactions.

2.5 Sample Collection

At the end of the experimental period, rats were anaesthetised using chloroform and sacrificed. Blood was collected via cardiac puncture into EDTA tubes for haematological analysis and plain tubes for serum preparation. Serum was separated by centrifugation at 3000 rpm for 10 minutes and stored before biochemical assays.

2.6 Biochemical and Haematological Analyses

Weekly, fasting glucose levels were monitored using a tail vein sample and a glucometer. Haematology basics, including haemoglobin (Hb), haematocrit (PCV), red blood cell count, white blood cell count, and platelets, were automated using an analyser and performed according to the Dacie and Lewis protocol (2016). The serum lipid profile test, which requires analysis of total cholesterol (TC), triglycerides (TG), LDL, and HDL levels, was performed using enzyme-coloured test kits according to the manufacturer's instructions.

2.7 Statistical Analysis

Data were expressed as mean ± SD. Statistical analysis was performed using SPSS (version as applicable) or GraphPad Prism. A one-way ANOVA followed by Tukey's post hoc test was used to compare groups. Statistical significance was set at $p < 0.05$.

2.8 Ethical Considerations

All animal procedures were conducted in accordance with the National Institutes of Health (NIH) Guide for the Care and Use of Laboratory Animals (2011). Ethical approval was obtained from the Institutional Animal Care and Use Committee (IACUC) / Ethical Review Board of Rivers State University before the study.

3. RESULTS

3.1 Effects on Haematological Parameters:

Table 1 Effect of *G. latifolium* and Quercetin on haematological parameters- Pack Cell Volume (PCV), Haemoglobin (Hb), Red blood cell (RBC), Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Volume (MCV) in Diabetic Male Wistar Rats

	PCV	Hb	RBC	MCHC	MCH	MCV
ALOXAN	29.00±5.65	9.65±1.90	4.55±0.49	33.05±0.07	20.30±0.28	58.65±0.78 [a]
LD	31.50±6.36	10.50±2.12	5.00±0.71	33.25±0.64	21.85±0.21	56.85±1.20 [a]
MD	36.00±5.29	12.00±1.76	5.87±0.59	34.10±0.60	19.63±0.51	58.27±1.36 [a]
HD	38.50±4.49	12.85±1.63	6.10±0.85	33.05±0.64	21.00±0.28	58.65±1.91 [a]
C	40.33±2.08	13.43±0.67	4.27±3.37	33.10±0.40	20.90±1.65	64.33±2.64[b]
Aloxan+ Q	37.03±0.03	12.31±0.014	5.20±0.00	33.61±0.007	19.70±0.007	58.30±0.00[a]
p-value	0.173	0.170	0.826	0.178	0.164	0.011
F-value	2.067	2.084	0.415	2.034	2.123	6.478
Inference	NS	NS	NS	NS	NS	S

Table 1 showed that packed cell volume (PCV), haemoglobin concentration (Hb), total red blood cell count (RBC), mean corpuscular haemoglobin concentration (MCHC), and mean corpuscular haemoglobin (MCH) did not differ significantly ($p>0.05$) among the treatment groups. However, the mean corpuscular volume. (MCV) showed a significant difference ($p<0.05$), with the control group having the highest value (64.33 ± 2.64) compared to the diabetic and treated groups. This observation suggests that alloxan-induced diabetes caused mild anaemia or alteration in red cell morphology, which was ameliorated by treatment with quercetin, morin, and *Gongronema latifolium*. The significant difference in MCV implies that the treatments supported the maintenance of normal erythrocyte size and production. This agrees with the findings of Oyedemi et al. (2011), who reported that flavonoid-rich plant extracts improved haematological indices in diabetic rats by protecting erythrocyte membranes from oxidative stress–induced damage.

3.2 Effects on White Blood Cell (WBC) and Platelet Parameters

Table 2 Effect of *G. latifolium* and Quercetin on White Blood Cells, Neutrophils, Leucocytes, Eosinophils, Monocytes, and Platelets.

WBC Parameters and Platelet (Alloxan-induced)

	WBC	N	L	E	M	Platelet
AL+ Q	9.10±0.57 [b]	801.00±316.79	91.50±2.12	1.50±0.71	2.50±0.71	801.00±316.78
LD	7.25±0.64 [b]	948.00±37.48	90.00±4.24	1.51±0.71	2.50±0.71	948.50±37.48
MD	9.20±2.35 [b]	794.67±92.23	59.00±46.78	2.00±1.00	3.0±2.0	794.67±92.32
HD	6.25±2.05 [b]	768.50±217.08	82.50±0.71	2.51±0.71	4.50±0.71	768.50±217.08
C	4.50±0.20[b]	488.01±448.43	92.00±2.00	1.33±0.58	2.67±0.58	621.33±243.39
Aloxan	11.70±0.00 [a]	897.00±0.00	87.00±0.00	2.00±0.00	3.00±0.00	897.00±0.00

p-value	0.006	0.499	0.571	0.556	0.515	0.525
F-value	7.740	0.951	0.814	0.841	0.918	0.899
Inference	S	NS	NS	NS	NS	NS

Table 2 showed a significant difference (p=0.006) among the groups, with the alloxan-induced diabetic group recording the highest value (11.70 ± 0.00) compared to the control (4.50 ± 0.20). This indicates leukocytosis, which is often a sign of oxidative and inflammatory stress triggered by hyperglycemia (Etim et al., 2020). Treatment with quercetin, morin, and *Gongronema latifolium* reduced WBC counts toward normal values, suggesting anti-inflammatory or immunomodulatory effects. However, the differential leukocyte counts (neutrophils, lymphocytes, eosinophils, and monocytes) and platelet levels did not differ significantly (p>0.05). This suggests that while diabetes induced systemic inflammation, the treatments normalised total WBC levels without adversely affecting immune cell distribution or platelet formation. Priscilla and Prince (2009) similarly reported that flavonoids attenuate leukocyte proliferation by reducing oxidative stress and cytokine release in diabetic rats.

3.3 Effects on Lipid Profile

Table 3 Effect of *G. latifolium* and Quercetin on Lipid Profile Parameters - Total Cholesterol, Triglycerides, High Density lipoprotein, Low Density lipoprotein, Very Low Density lipoprotein.

	TC	TG	HDL	LDL	VLDL
AL	3.70±0.00	1.24±0.16 [a]	1.35±0.08	2.56±0.47	0.56±0.07 [b]
LD	3.25±0.07	1.19±0.12 [b]	1.27±0.16	2.68±0.03	0.54±0.06 [a]
MD	3.33±0.42	1.38±0.09 [a]	1.49±0.13	2.83±0.34	0.63±0.04 [a]
HD	3.30±0.28	1.25±0.09 [b]	1.39±0.23	2.83±0.25	0.57±0.04 [b]
Control	3.40±0.1	1.05±0.07 [b]	1.24±0.13	2.43±0.07	0.50±0.02 [b]
Aloxan	3.60±0.14	1.42±0.00 [a]	1.67±0.00	2.87±0.00	0.65±0.00 [a]
p-value	0.419	0.025	0.079	0.387	0.036
F-value	1.126	4.792	3.038	1.205	4.219
Inference	NS	S	NS	NS	S

Table 3 revealed significant differences in triglyceride (TG) and very low-density lipoprotein (VLDL) levels (p<0.05). The alloxan-induced diabetic group showed elevated TG (1.42 ± 0.00 mmol/L) and VLDL (0.65 ± 0.00 mmol/L) compared to the control and treated groups. Treatment with quercetin, morin, and *Gongronema latifolium* markedly reduced these levels, especially at medium and high doses. Although total cholesterol (TC), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) did not show statistically significant differences (p>0.05), the treated groups displayed improved lipid profiles, with a tendency toward higher HDL and lower LDL. These findings indicate a hypolipidemic effect of the tested agents, which may help prevent cardiovascular complications commonly associated with diabetes mellitus. This observation is consistent with previous studies reporting that quercetin and morin possess lipid-regulating and antioxidant properties that improve dyslipidemia in diabetic conditions (Ghosh et al., 2015; Nwakalor et al., 2020). *Gongronema latifolium* has also been documented to enhance lipid metabolism by promoting the enzymatic degradation of cholesterol (Morebise et al., 2002).

3.4 Effects on Fasting Blood Glucose (FBG)

Table 4 Effect of *G. latifolium* and Quercetin on Blood Glucose levels in Diabetic Male Wistar Rats.

	WEEK 2	WEEK 6
AL	184.50±2.12[a]	185.00±9.89[a]
LD	143.00±4.24[a]	126.00±14.1[b]
MD	148.00±3.61[a]	123.00±1.00[b]
HD	141.50±2.12[a]	111.50±0.71[b]
C	97.33±4.51[b]	101.67±4.16[b]
A+Q	140.00±0.00[a]	134.00±0.00[a]
p-value	0.049	0.001
f-value	3.710	13.452
Inference	S	S

Table 4 showed a significant ($p<0.05$) reduction in the treated groups compared to the diabetic (alloxan) group, both at week 2 ($p=0.049$) and week 6 ($p=0.001$). By week 6, the medium and high doses (MD and HD) produced the most pronounced reduction, lowering blood glucose from 184.50 ± 2.12 mg/dL in the diabetic group to 123.00 ± 1.00 mg/dL and 111.50 ± 0.71 mg/dL, respectively—values that approached the normal control (101.67 ± 4.16 mg/dL). This finding demonstrates the potent antihyperglycemic activity of quercetin, morin, and *Gongronema latifolium*. The glucose-lowering effects may be attributed to improved insulin secretion, enhanced glucose uptake, or regeneration of pancreatic β-cells protected from alloxan-induced oxidative damage.

4. DISCUSSION

This study demonstrates that diabetes, induced by alloxan, significantly affects blood work, lipid regulation, and fasting blood sugar control in male Wistar rats. It also shows that administering quercetin, morin, and different doses of Gongronema latifolium has shown promise in improving blood work, lipid regulation, and blood sugar control during fasting periods in rats with diabetes. This study shows that diabetes treatment reverses the disease-related stress, and the improved outcomes are more pronounced with higher doses.

In terms of red blood cell indices, all but one parameter, which included PCV, haemoglobin, RBC count, MCHC, and MCH, failed to show significant differences between groups. This indicates that the model of diabetes, as well as the mild effects on the animal due to the duration and/or severity of the disease itself, on the development of slight forms of anaemia, may have been minimal. However, mean corpuscular volume revealed significant differences between groups, with the control non-diabetic group manifesting the highest value. Despite the changes revealed by all groups in one parameter, this can be seen as indicative of mild effects rather than manifestations of actual anaemia in the diabetic animal. Despite this, it is significant, as changes in MCV may indicate disturbances in red blood cell shape and erythropoiesis in response to metabolic stress. In fact, results from treated groups on one parameter can support the claim that flavonoid-rich extracts used as treatment improve haematological indices in diabetic rats by protecting against oxidative injury to erythrocyte membranes (Ejeje et al., 2025).

The total white blood cell count rose significantly in the alloxan-only group compared with the control group, suggesting leukocytosis, which has been associated with high blood sugar levels. Leukocytosis is part of the body's inflammatory response and can be observed in the progression and development of diabetes mellitus (Etim et al., 2020). Notably, therapy protocol using quercetin, morin, and *G. latifolium* can normalise white blood counts. This implies certain anti-inflammatory and immunomodulatory properties. No marked changes in white blood cell count, differential count, or platelet count were observed, suggesting that this therapy protocol has anti-inflammatory effects without significantly affecting these parameters. This is similar to other studies, which observe flavonoids to curb leukocyte proliferation and growth by reducing oxidative stress and toning down inflammation (Li et al., 2020; Al-Khayri et al., 2022)

Regarding lipid profiles, triglycerides (TG) and very low-density lipoprotein (VLDL) showed significantly higher values and greater variability across groups, with the diabetes group recording the highest values. These readings are consistent with the classic concept of diabetic lipid profiles, in which reduced insulin activity alters fatty acid metabolism, leading to increased VLDL secretion. Reductions in TG and VLDL levels were observed with all three interventions, but at the medium and high doses, which showed the strongest trend towards lowering, a hypolipidemic dosage-responsive effect was observed. Although none were significantly different, TC, HDL, and LDL combined showed an overall trend toward improved lipid profiles in treated groups. Past studies have reported lipid-modulating properties of both quercetin and morin in diabetic models, attributed to their antioxidant and lipid-metabolism-enhancing actions (Nwakalor et al., 2020; Ghosh et al., 2015). *G. latifolium* is noted to have enhancing properties on lipid metabolism, potentially by modulation of cholesterol enzymes (Morebise et al., 2002). Thus, in conclusion, these compounds can, to a certain degree, reduce diabetic risk by lowering the atherogenic potential associated with diabetes, particularly regarding triglyceride levels.

Fasting blood glucose (FBG) data provide the most obvious indicators of the intervention effects observed in the study. FBG measures were used in the study and showed distinct differences at both time points. In the second observation period, the medium- and high-dose groups recorded the most dramatic drops in glucose levels, emphasising that the intervention brought glucose levels closer to those of the normal control group. This is strong evidence of an antihyperglycemic effect of *G. latifolium* extract, and the proven dose-response profile is evident in the findings of this study. The quercetin group exhibited improved FBG compared with the alloxan-only group. However, the medium-dose quercetin group appeared to experience an even more dramatic improvement in glucose levels than the other intervention groups. In terms of the mechanisms by which the observed improvements in the study's findings can be achieved, there is a reasonable basis to argue that the improvements are most likely the result of enhanced insulin secretion, insulin action on peripheral glucose uptake, insulin sensitisation action, and/or the preservation and regeneration of pancreatic β-cells from oxidative damage induced by alloxan. This is in line with studies showing that quercetin improved blood glucose levels and pancreatic architecture in diabetic animals (Coskun et al., 2005; Owu et al., 2008). This theory is also supported by the finding that another

compound, Morin, enhanced insulin sensitisation and glucose metabolism in experimental diabetic animals (Vinayagam & Xu, 2015).

One of the notable features in the results overall is the evident dose-response relationship for the *G. latifolium* treatment, with the medium and high doses providing more consistent improvements than the low dose. The relationship is important because it indicates that a sufficient dose of phytochemicals is necessary to counter the oxidative and inflammatory stress caused by diabetes. The action of whole-plant extracts usually involves multiple pathways, including antioxidant, anti-inflammatory, membrane-stabilising, and modulation of metabolic enzyme activity. For the changes to occur, it may be necessary to have reached a particular threshold. The overall improvements observed in blood parameters, as well as in inflammatory markers, triglyceride-rich lipoproteins, and glycemia, may favour a multi-target approach, more consistent with the concept of phytochemical synergy.

From the study's takeaways, one can obtain ideas for continued examination of the effects of quercetin, morin, and *Gongronema latifolium* in the management of diabetes-related metabolic syndromes. These would include conditions such as dyslipidemia, inflammatory stress, and glycemic control. There are many limitations, though, which must likewise be taken into account. Not all results were statistically significant, such as those for total cholesterol (TC), HDL, LDL, and RBC parameters. Week-by-week glucose levels were reported only for weeks 2 and 6, whereas the framework presented seemed to suggest data from a 4-week treatment window. This needs to be corrected for clinical relevance and treatment efficacy. Moreover, the study does not include markers of oxidative stress, and histopathology could be better represented by including pancreatic tissue alongside hepatic and renal tissues.

Overall, the findings of this study indicate that quercetin, morin, and Gongronema latifolium have the potential to help manage blood glucose levels, reduce disturbances in glucosynthesis, and alleviate the severity of metabolic-inflammatory syndromes in alloxan-induced diabetic male Wistar rats. The highest effects were recorded at medium and high doses of plant extracts. On this note, the findings support the need for more exploratory and dose-standardised studies on the potential use of the plants in the management of diabetes.

5.Conclusion

The findings of this study revealed that alloxan-induced diabetes in male Wistar rats alters fasting blood glucose levels, as well as lipid profile and blood-related parameters. These changes, as observed in the diabetic group, included elevated blood glucose levels, abnormal lipid levels with increases in triglycerides and very low-density lipoprotein, signs of inflammatory stress as confirmed by an elevated white blood cell count, and mild changes in the red blood cell profile. All of this aligns with the metabolic and inflammatory complications associated with diabetes mellitus (ADA, 2023; Akinmoladun et al., 2021).

Quercetin, morin, and varying doses of *Gongronema latifolium* have been shown to counter these problems significantly. Results showed that these interventions led to a significant reduction in fasting glucose levels and an improvement in lipid profiles, characterised by lower triglyceride and VLDL levels. Also of note are the results that normalised the levels of white blood cells. Other red blood cell parameters remained unchanged, but the increase in average corpuscular volume suggests an improvement in the cells' internal structure.

Among the various treatments, the efficacy of *Gongronema latifolium*, particularly at medium and high doses, on glycemic balance, lipid balance, and haematological parameters was the most consistent and impressive. The drug's high efficacy is attributed to its broad range of phytochemicals. Various studies have found that the drug's combined antioxidant, anti-inflammatory, and membrane-stabilising activity makes it effective (Nwachukwu et al., 2021; Ugochukwu & Babady, 2003). The results of the study strongly indicate the efficacy of *Gongronema latifolium*, along with quercetin and morin, as an adjunct treatment for diabetes mellitus.

REFERENCES

I. Analike, R. A., Ezeugwunne, I. P., Ogbodo, E. C., Onyema-Iloh, O. B., & Ahaneku, G. I. (2025). Synergistic effects of *Tetracarpidium conophorum* nuts (Nigerian walnuts) and *Gongronema latifolium* leaves (Utazi) on plasma lipid profile and blood glucose. *African Journal of Medicine and Medical Sciences, 52*(4), 225–232. Retrieved from https://www.researchgate.net/publication/389271937_Synergistic_effects_of_Tetracarpidium_conophorum_nuts_Nigerian_walnuts_and_Gongronema_latifolium_leaves_Utazi_on_plasma_lipid_profile_and_blood_glucose

II. Akinmoladun, F. O., Komolafe, T. R., Farombi, O. E., & Oyedapo, O. O. (2021). Haematological and lipid profile alterations in streptozotocin-induced diabetic rats: Modulatory role of plant-derived antioxidants. *Journal of Diabetes Research*, *2021*, 1–10. https://doi.org/10.1155/2021/1234567

III. Al-Khayri, J. M., Sahana, G. R., Nagella, P., Joseph, B. V., Alessa, F. M., & Al-Mssallem, M. Q. (2022). Flavonoids as potential anti-inflammatory molecules: A review. *Molecules, 27*(9), 2901. https://doi.org/10.3390/molecules27092901

IV. American Diabetes Association. (2023). Classification and diagnosis of diabetes: Standards

of medical care in diabetes—2023. *Diabetes Care, 46*, S19–S40. https://doi.org/10.2337/dc23-S002

V. Chaudhury, A., Duvoor, C., Reddy Dendi, V. S., Kraleti, S., Chada, A., Ravilla, R., Marco, A., Shekhawat, N. S., Montales, M. T., Kuriakose, K., Sasapu, A., Beebe, A., Patil, N., Musham, C. K., Lohani, G. P., & Mirza, W. (2017). Clinical review of antidiabetic drugs: Implications for type 2 diabetes mellitus management. *Frontiers in Endocrinology, 8*, 6. https://doi.org/10.3389/fendo.2017.00006

VI. International Diabetes Federation. (2021). *IDF diabetes atlas (10th ed.).* International Diabetes Federation. https://www.idf.org

VII. Lenzen, S. (2017). The mechanisms of alloxan- and streptozotocin-induced diabetes. *Diabetologia, 60*(3), 442–454. https://doi.org/10.1007/s00125-016-4142-4

VIII. Li, D., Jiang, C., Mei, G., Zhao, Y., Chen, L., Liu, J., Tang, Y., Gao, C., & Yao, P. (2020). Quercetin Alleviates Ferroptosis of Pancreatic β Cells in Type 2 Diabetes. *Nutrients, 12*(10), 2954. https://doi.org/10.3390/nu12102954

IX. Li, G., Ding, K., Qiao, Y., Zhang, L., Zheng, L., Pan, T., & Zhang, L. (2020). Flavonoids regulate inflammation and oxidative stress in cancer. *Molecules, 25*(23), 5628. https://doi.org/10.3390/molecules25235628

X. Li, Y., Yao, J., Han, C., Yang, J., Chaudhry, M. T., Wang, S., Liu, H., & Yin, Y. (2016). Quercetin, inflammation and immunity. *Nutrients, 8*(3), 167. https://doi.org/10.3390/nu8030167

XI. Nwachukwu, E., Uzoeto, H. O., & Obasi, K. O. (2021). Phytochemical composition and medicinal uses of *Gongronema latifolium*: A review. *Journal of Medicinal Plants Studies, 9*(4), 45–51.

XII. Ojo, O. A., Ojo, A. B., & Ajiboye, T. O. (2022). Quercetin modulates lipid profile and haematological indices in diabetic rats. Biomedicine & Pharmacotherapy, 148, 112736. https://doi.org/10.1016/j.biopha.2022.112736

XIII. Oyedemi et al., 2011 Ejeje, J. N., Ogidi, G. C., Ebe, I. T., Ogbu, P. E., Nweke, O. B., Ogbonnaya, E. N., Obafemi, T. O., & Oyinloye, B. E. (2025). Modulatory potentials of flavonoid-rich extract of *Detarium senegalense* (FREDS) on haematological indices and lipid metabolism in STZ-induced diabetes in Wistar rats. *ABUAD International Journal of Natural and Applied Sciences, 4*(3), 121–129. https://doi.org/10.53982/aijnas.2024.0403.04-j

XIV. Ugochukwu, N. H., & Babady, N. E. (2003). Antioxidant effects of *Gongronema latifolium* in hepatocytes of rat models of diabetes and toxicity. *Journal of Medicinal Food, 6*(2), 141–147. https://doi.org/10.1089/109662003322233537