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RENOPROTECTIVE AND HEPATOPROTECTECTIVE POTENTIALS OF L-ARGININE AND GLUTAMATE ON STREPTOZOTOCIN INDUCED DIABETIC ALBINO RATS

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ABSTRACT

Diabetes mellitus is one of the most common metabolic disorders globally. L-arginine and glutamate have promising beneficial effects against metabolic disorders. Renoprotective and Hepatoprotectective potentials of L-Arginine and Glutamate on Streptozotocin Induced Diabetic albino rats. A total of 73 adult albino rats were used. Out of this, 13 rats were used for LD_{50} study while 60 rats were used for the proper study. They were grouped into 6, Group 1 served as Normal control, Group 2-6 were diabetic rats induced with streptozotocin (120mg/kg bwt) served as Diabetic control (administered only 0.2 ml normal saline daily). Groups 3, 4, 5 and 6 rats were diabetic rats given Glibenclamide (3 mg/kg bwt), L-Arginine (50 mg/kg bwt), Glutamate (50 mg/kg bwt), L-Arginine and Glutamate (50 mg/kg bwt), respectively for 30 days. After the treatment period, the animals were sacrificed; blood sample collected, and serum separated for determination of liver function status, lipid profile, kidney function markers, There were significant ($P<0.05$) decrease in the activities of AST and ALT when the treatment groups were compared to the diabetic group, the L-arginine group showed the lowest AST activity followed by the Glibenclamide control group then the group co-treated with L-arginine and glutamate. The effects of L-arginine and glutamate on renal function; urea, creatinine showed a significant decrease ($p<0.05$) in the l-arginine and glutamate treated group when compared to the diabetic group, and in sodium, potassium and chloride levels when compared to the drug control group. It could be concluded that L-arginine and glutamate have also showed reno-protective and hepato-protective potentials.

INTRODUCTION

BACKGROUND OF THE STUDY

l- Arginine and glutamate supplementation on streptozotocin induced albino rat has been widely studied in the context of oxidative stress, diabetes and Metabolic syndrome (MES), which is clustering of abnormalities including obesity, lipid and glucose disorders that confer an increased risk of developing not only cardiovascular disease but also type 2 diabetes mellitus (Wilson *et al.,* 2017) and colorectal cancer (Siddiqui, 2015; Pelucchi *et al.,* 2016). Although the pathogenesis of the metabolic syndrome is multifaceted, reports suggest a significant impact from impaired nitric oxide synthesis that could lead to insulin resistance and, possibly, vice versa. Garlichs *et al*. (2000) noted that MES might result from endothelial dysfunction characterized by a reduced availability of bioactive NO, perhaps following impaired endothelial nitric oxide (NO)-mediated vasodilatation that may result in decreased blood flow to skeletal muscle. According to the World Health Organization (WHO, 2000) diabetes mellitus is a chronic, metabolic disease characterized by elevated levels of blood glucose, which leads over time to damage to the heart, vasculature, eyes, kidneys and nerves. Over 90% of diabetes mellitus cases are T2DM, a condition marked by deficient insulin secretion by pancreatic islet β-cells, tissue insulin resistance (IR) and an inadequate compensatory insulin secretory response. The progression of the disease makes insulin secretion unable to maintain glucose homeostasis, producing hyperglycemia.
The augmentation of NO production/release induced by L-arginine may act as an antioxidant, possibly through a NO-mediated pathway (Kawano *et al*., 2020). Earlier studies have showed that NO terminated oxidant stress in tissues by suppressing iron-induced generation of hydroxyl radical (OH•) via the Fenton reaction, interrupting the chain reaction of lipid peroxidation, augmenting the anti-oxidative potency of the reduced glutathione (GSH) and inhibiting cysteine protease (Chiueh, 2019).

ROLE OF THE L-ARGININE-NITRIC SIGNALING PATHWAY

The molecular mechanism of NO, polyamines, and their precursor ARG in stimulating insulin synthesis and release, activating insulin receptors and endogenous antioxidants, is critical in diabetes mellitus – a major component of metabolic syndrome (Kawano *et al*., 2020). As coronary heart disease is the leading cause of morbidity and mortality in the Western world, elucidation of the signal transduction mechanisms modulating NO production may provide novel targets for therapeutic intervention. Nitric oxide (NO) is a labile vasodilator synthesized in endothelial cells from the semi-essential cationic amino acid L-arginine and diffuses rapidly to underlying smooth muscle cells to activate soluble guanylyl cyclase and vascular relaxation (Wu & Morris, 2018).

Streptozotocin (STZ) is a chemical naturally occurring compound; it also an antibiotic, Produced by the bacterium *Streptomyces achromogenes which* destroys insulin-producing beta cells in the pancreas by inducing diabetes into lab animals (like rats or mice) there by damaging their pancreatic beta cells. The mechanism of action of streptozotocin (STZ) involves multiple biochemical pathways, but its main effect is to selectively destroy pancreatic beta cells, which are responsible for insulin production (Marino *et al.,* 2023).

MECHANISM OF ACTION OF STREPTOZOTOCIN (STZ)

Selective uptake by beta cells, STZ is taken up primarily by pancreatic beta cells via the GLUT2 (glucose transporter 2), Beta cells have a high expression of GLUT2, making them especially vulnerable. DNA Alkylation Once inside the cell, STZ acts as a nitrosourea compound, which means it: Transfers its methyl group to DNA bases (primarily guanine). Marino *et al.,* (2023) DNA alkylation leads to DNA strand breaks and mutations. This DNA damage triggers the cell's repair mechanisms. Activation of Poly (ADP-ribose) Polymerase (PARP) The DNA damage leads to over activation of PARP, a DNA repair enzyme. Excessive PARP activation, depletes cellular NAD+ and ATP, results in energy failure and cell death. Marino *et al.,* (2023)

MATERIAL AND METHODS

ANIMALS

A total of 73 male adult albino rats were used for the study. Out of this 13 rats were used for LD_{50} study while 60 were used for the study proper. Adult male albino rats weighing between 150-200g were obtained from the Animal House of the Department of Zoology and Environmental Biology, Federal University Gashua Yobe State, housed in Aluminum cages and allowed to acclimatize for two weeks to allow for proper adaptation to their new environment and living conditions before commencement of the study. The experimental rats were fed at liberty with Vita Finisher's mash (Vital Feeds, Nigeria) and clean water at libitum starved for 12 hours before the commencement of the experiment. All animal experiments were conducted in compliance with international guidelines for the care and use of laboratory animals (Orieke *et al*., 2019). The study was conducted in the Department of Biochemistry Federal University Gashua Yobe State

INDUCTION OF DIABETES MELLITUS

Animals were made diabetic via single intraperitoneal administration of Streptozotocin (120 mg/kg body weight) and diabetes mellitus was confirmed 72hrs after induction. sample were collected for 2hrs pre induction and 4hrs post induction by determining blood sugar levels of all induced animals using a single touch glucometer (ACCUCHEK ACTIVE). Animals with blood glucose levels of 180 mg/dl and above were considered diabetic and were used for the study.

2.2 **Experimental design for the anti-diabetic study**

The rats were assigned to 6 groups of 10 rats each and were treated according to the order below: **Group 1** rats were not made diabetic and remained normal throughout the period of the study. Animals in groups 2-6 were made diabetic and treated as indicated.

Group 2: Diabetic control (administered only 0.2 ml normal saline daily)
Group 3: Diabetic + Glibenclamide (3 mg/kg)
Group 4: Diabetic + L-Arginine (50 mg/kg bw)
Group 5: Diabetic + Glutamate (50 mg/kg bw)
Group 6: Diabetic + L-Arginine and Glutamate (50 mg/kg bw)

At the end of the 7th, 14th and 28th days' treatment period, the sugar levels of rats were determined using a single touch ACCU CHECK glucometer on blood collected from each animal's tail by tail snip. Body weights of all animals were also measured using an electronic balance at the beginning and end of treatment. All animals were also sacrificed after 30 days and blood was collected into EDTA and plain bottles for hematological and biochemical analyses respectively.

SAMPLE COLLECTION AND PREPARATION

A known quantity, 1g of the powdered form of the L-Arginine and Glutamate supplements each was dissolved in 50ml of water and allowed to stand for 2 hours. The resulting solutions were then prepared to a concentration of 25mg/ml per body weight of the rats. The volume of supplement was administered based on body weight was calculated using the formula. (Laxminatrain and Hildbert, 2007).

Volume=D×P⁄C

Where D= Dose to be administered.
P= body weight of animal weight .
C= concentration of the stock.

STATISTICAL ANALYSIS

Results obtained were expressed as Mean ± SEM. One-way analysis of variance (ANOVA) was used to analyze the result using statistical product, service and solutions (SPSS) version 25. Duncan multiple range test was used as post-hoc tool to compare P- Values less than 0.05 were considered statistically significantly different between the test and control groups as well as among test groups for measured value.

RESULTS AND DISCUSSION

EFFECT OF L-ARGININE AND GLUTAMATE ON LIVER FUNCTION PARAMETERS IN STREPTOZOTOCIN-INDUCED DIABETIC RATS

The result of the AST showed significant decrease ($p \leq 0.05$) across the group when compared to that of the diabetic group. The L-Arginine group showed the lowest AST activity (51.60±0.65) followed by the drug control group (52.56±0.66), then the group co-treated with both L-arginine and Glutamate (60.25±0.65) and finally the glutamate group (90.28±1.68).

The result of the ALT showed significant ($p \leq 0.05$) decrease when compared to that of the diabetic group. The drug control group showed the lowest ALT activity (50.56±1.05) followed by the L-Arginine (54.93±0.93), then the group co-treated with both L-arginine and Glutamate (57.25±0.65) while the glutamate group was the highest (74.28±1.04).
The result of the ALP showed significant ($p \leq 0.05$) decrease when compared to that of the diabetic group. The drug control group showed the lowest ALP activity (83.89±0.94) followed by the L-Arginine (86.93±0.78), then the group co-treated with both L-arginine and Glutamate (106.25±1.42) while the glutamate group was the highest (108.95±2.05).
The result of the total bilirubin showed significant ($p \leq 0.05$) decrease in concentration compared when to that of the diabetic group. The L-Arginine group showed the lowest concentration (0.66±0.07) followed by the drug control (0.65±0.11), then the group co-treated L-arginine and Glutamate (0.89±0.08) and finally the glutamate group (1.03±0.06).

The result of the total protein showed significant ($p \leq 0.05$) increase in concentration when compared to that of the diabetic group. The drug control group showed the highest increase (5.41±0.13) followed by the glutamate group (5.17±0.07) then the L-Arginine (5.16±0.11), and finally the group co-treated L-arginine and Glutamate (5.09±0.10).
The result of the globulin concentration showed significant ($p \leq 0.05$) increase when compared to that of the diabetic group. The drug control group showed the highest increase (2.40±0.13) followed by the L-Arginine (2.39±0.09), then the group co-treated L-arginine and Glutamate (2.07±0.09) while the. L glutamate was the lowest (2.07±0.07).

The result of the albumin concentration showed significant ($p \leq 0.05$) increase when compared to that of the diabetic group. The glutamate showed the highest increase (3.05±0.06) followed by co-treated L-arginine and Glutamate (2.94±0.09), then the drug control (2.90±0.11) while the L-Arginine group was the lowest (2.70±0.15).

Treatment	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	ALT (U/L)	AST (U/L)	ALP (U/L)	Total bilirubin (mg/dl)
Normal control	5.91±0.09^{c}	3.20±0.01^{c}	2.70±0.09^{b}	25.99±0.93^{a}	36.66±0.79^{a}	67.32±0.65^{a}	0.55±0.01^{a}
Diabetic control	4.20±0.17^{a}	1.94±0.17^{a}	2.09±0.18^{a}	89.83±0.79^{e}	123.83±3.23^{e}	135.16±1.43^{d}	1.35±0.17^{d}
Diabetic + Glibenclamide (3 mg/kg)	5.41±0.13^{b}	2.90±0.11^{bc}	2.40±0.13^{ab}	50.56±1.05^{b}	52.56±0.66^{b}	83.89±0.94^{b}	0.65±0.11^{ab}
Diabetic + L-Arginine (50 mg/kg bw)	5.16±0.11^{b}	2.70±0.15^{b}	2.39±0.09^{ab}	54.93±0.93^{c}	51.60±0.65^{b}	86.93±0.78^{b}	0.66±0.07^{ab}
Diabetic + Glutamate (50 mg/kg bw)	5.17±0.07^{b}	3.05±0.06^{c}	2.07±0.07^{a}	74.28±1.04^{d}	90.28±1.68^{d}	108.95±2.05^{c}	1.03±0.06^{c}
Diabetic + L-Arginine and Glutamate (50 mg/kg bw)	5.09±0.10^{b}	2.94±0.09^{bc}	2.07±0.09^{a}	57.25±0.65^{c}	60.25±0.65^{c}	106.25±1.42^{c}	0.89±0.08^{bc}

Results were presented as mean ± SEM and Values within a column having the same superscripts letters are not significantly different at p≤0.0

EFFECT OF L-ARGININE AND GLUTAMATE ON RENAL FUNCTION PARAMETERS OF STREPTOZOTOCIN-INDUCED DIABETIC RATS

The urea result showed significant (p≤0.05) decrease across the treated groups when compared to the diabetic group. The group 3 showed the lowest concentration (25.60±1.14) followed by the group co-treated L-Arginine and glutamate (29.72±0.31), then the L-Arginine group (31.46±0.83), finally the glutamate group (39.43±1.06).

The creatinine result showed significant (p≤0.05) decrease across the treated groups when compared to the diabetic group. The L-Arginine showed the lowest concentration (0.84±0.01) followed by drug control group (0.97±0.02), then the co-treated L-Arginine and glutamate (1.07±0.11) and finally the glutamate group (1.28±0.20), The sodium result showed significant (p≤0.05) increase across the treated groups when compared to the diabetic group. The L-Arginine showed the highest concentration (129.26±0.84) followed by drug control group (128.20±0.84), then the group co-treated L-Arginine and glutamate (126.08±0.39) and then the glutamate group (126.89±0.28).

The potassium result showed significant (p≤0.05) increase across the treated groups when compared to the diabetic group. The group co-treated L-Arginine and glutamate showed the highest concentration (4.28±0.11) followed by, glutamate group (4.12±0.21), then the drug control group (3.81±0.50) and finally L-Arginine (3.39±0.74).

The chloride result showed significant (p≤0.05) increase across the treated groups compared to the diabetic group. The L-Arginine showed the highest concentration (87.34±0.79) followed by drug control group (85.76±0.64), then the group the glutamate group (82.75±0.70) and finally co-treated L-Arginine and glutamate (81.88±0.79).

The bicarbonate result showed significant (p≤0.05) decrease in concentration across the treated groups compared to the group 2. The L-Arginine showed the lowest concentration (18.85±0.74) followed by drug control group (19.45±0.50), then the group 6 co-treated L-Arginine and glutamate (20.06±0.12) and finally the group 5 (20.07±0.20).

Treatments	Urea (mg/dl)	Creatinine (mg/dl)	Na^{+} (mEq/L)	K^{+} (mEq/L)	Cl^{-} (mEq/L)	HCO_3^{-} (mEq/L)
Normal control	16.20±0.28^{a}	0.68±0.02^{a}	130.98±0.71^{e}	4.47±0.16^{a}	88.35±0.30^{d}	19.53±0.16^{a}
Diabetic control	40.40±0.55^{d}	1.68±0.04^{d}	120.10±0.52^{a}	3.91±0.09^{a}	77.43±0.68^{a}	20.21±0.43^{a}
Diabetic + Glibenclamide (3 mg/kg)	25.60±1.14^{b}	0.97±0.02^{ab}	128.20±0.84^{cd}	3.81±0.50^{a}	85.76±0.64^{c}	19.45±0.50^{a}
Diabetic + L-Arginine (50 mg/kg bw)	31.46±0.83^{c}	0.84±0.01^{ab}	129.26±0.84^{de}	3.39±0.74^{a}	87.34±0.79^{cd}	18.85±0.74^{a}
Diabetic + Glutamate (50 mg/kg bw)	39.43±1.06^{d}	1.28±0.20^{c}	126.89±0.28^{bc}	4.12±0.21^{a}	82.75±0.70^{b}	20.07±0.20^{a}
Diabetic + L-Arginine and Glutamate (50 mg/kg bw)	29.72±0.31^{c}	1.07±0.11^{bc}	126.08±0.39^{b}	4.28±0.11^{a}	81.88±0.79^{b}	20.06±0.12^{a}

Results were presented as mean ± SEM (n = 6); and Values within a column having the same superscripts letter are not significantly different at p≤0.05

EFFECT OF L-ARGININE AND GLUTAMATE ON SERUM ANTIOXIDANT PARAMETERS IN STREPTOZOTOCIN-INDUCED DIABETIC RATS.

The antioxidant result showed significant (P≤0.05) increase in the serum antioxidant activities of the groups 6 when compared to that of the diabetic group. The result of the GSH concentration showed that L-Arginine group have the highest concentration (11.26±0.35), followed by the group co-treated with both L-Arginine and glutamate (10.80±0.12), then the drug control group (10.34±0.24), finally the glutamate group (10.27±0.13).

The result of the GPx activity showed that the group treated with both L-Arginine and glutamate has the highest activity (40.21±0.05), followed by the L-Arginine group (37.58±0.50), then the drug control group (36.65±0.39), finally the glutamate group (32.71±0.17).

The result of the SOD activity showed that the group treated with both L-Arginine and glutamate group have the highest activity (27.07±0.17) followed by the drug control (26.98±0.28), L-Arginine group (26.64±0.45), then the group, then glutamate group (25.53±0.07).

The result of the CAT activity showed that L-Arginine group have the highest activity (18.57±0.40), followed by the group co-treated with L-Arginine and glutamate (18.13±0.13), then the drug control group (17.51±0.27), finally the glutamate group (17.06±0.11).

The result of the MDA concentration showed that the drug control group have the lowest concentration (0.33±0.02), followed by the L-Arginine group (0.38±0.03), then the group co-treated with L-Arginine and glutamate (0.42±0.05) then finally the glutamate group (0.42±0.05).

Result of effect of L-Arginine and Glutamate on serum antioxidant parameters in streptozotocin-induced diabetic rats

Treatments	GSH (mg/dl)	GPx (u/l)	SOD (u/l)	CAT (mg/dl)	MDA (mMol/L)
Normal control	13.56±0.29^{d}	42.70±0.61^{e}	31.59±0.47^{d}	19.56±0.42^{d}	0.20±0.01^{a}
Diabetic control	9.28±0.14^{a}	29.69±0.21^{a}	24.18±0.08^{a}	16.70±0.27^{a}	0.61±0.07^{c}
Diabetic + Glibenclamide (3 mg/kg)	10.34±0.24^{b}	36.65±0.39^{c}	26.98±0.28^{c}	17.51±0.27^{ab}	0.33±0.02^{b}
Diabetic + L-Arginine (50 mg/kg bw)	11.26±0.35^{c}	37.58±0.50^{c}	26.64±0.45^{c}	18.57±0.40^{c}	0.38±0.03^{b}
Diabetic + Glutamate (50 mg/kg bw)	10.27±0.13^{b}	32.71±0.17^{b}	25.53±0.07^{b}	17.06±0.11^{a}	0.58±0.04^{c}
Diabetic + L-Arginine and Glutamate (50 mg/kg bw)	10.80±0.12^{bc}	40.21±0.05^{d}	27.07±0.17^{c}	18.13±0.13^{bc}	0.42±0.05^{b}

Result were presented as mean ± SEM (n = 6); and Values within a column having the same superscripts letter are not significantly different at p≤0.05

DISCUSSION

Type 2 diabetes mellitus (T2DM) affects about 85% of patients with diabetes mellitus. It can be brought on by environmental factors, genetic predisposition, or a combination of the two (Jafari-Vayghan et al., 2020). This study determined renoprotective and hepatoprotectective potentials of l-arginine and glutamate on streptozotocin induced diabetic albino rats.

2,2 diphenyl-1-picrylhydrazyl (DPPH) radical-scavenging ability is regarded as its total capacity of scavenging free radicals (Xu *et al*., 2018). Therefore, the scavenging activity of the OH radical is an important indicator for the evaluation of the capacity of antioxidants to prevent lipid and protein oxidation (Xu *et al*., 2018). The dose-dependent increase in % inhibition across the group both L-Arginine and L-glutamate is indicative of their anti-oxidant properties which agree with previous studies by Takashima *et al.,* (2024). Hence, L-arginine and L-glutamate could scavenge DPPH and OH radicals and may play an important role in blocking the propagation of free radicals during lipid and protein oxidation (Baliyan *et al*., 2022). Though the mechanism is not clear, the result indicated that L-Arginine has higher DPPH scavenging power compared to L-glutamate.

The common parameters used in assessing liver function are AST, ALT, and ALP activities. (Obidike and Mbah, 2024). The major enzymes assayed for diagnosis of hepatic injuries include AST, ALT and ALP with ALT being implicated as the most specific for hepatic assault. An increase in the activity of these enzymes could be an indication of hepatic injuries (Obidike and Mbah, 2024).

The result of the AST and ALT of the L-arginine and L-glutamate indicated significant reduction compared to the streptozotocin induced diabetic untreated group, (group 2) which is indicative of hepato-protective potential of the amino acids. Though the mechanism for this feat is not clear, it could possibly be that both supplements reduced/reversed the toxicity through their antioxidant potential as previously shown by their DPPH scavenging potentials. The better hepato-protective potential noticed in the L-arginine group could also be attributed to its higher antioxidant potential as indicated by higher percentage scavenging power noticed in the result. This therefore agrees

with the result of Obidike and Mbah (2024) that supplements with antioxidant potential could have hepato-protective potentials. The decrease in the ALP activity as seen in the result is indicative of membrane protective potentials of L-arginine, L-glutamate and co treated group 6 when compared to the diabetic group. Labialization of the membranes causes outflow of liver enzymes which causes increase in serum activity (Egbuonu *et al*., 2018). Hence, the reduced activity in the groups could be indicative that the supplements protected the cellular membranes from Streptozotocin toxicity leading to reduced outflow of hepatic enzymes.

The reduction in urea and creatinine concentration in the groups treated with L-Arginine and L-Glutamate when compared with diabetic control group could be implicative of renal protection of the supplements against the toxicity induced by Streptozotocin. This agrees with the result of Obidike and Egbuonu, (2020) that administration of reno-protective agent cause reduction in the serum concentration of urea and creatinine. Though the mechanism for this is not clear, it could however be due to the antioxidant properties of L-Arginine and L-Glutamate. However, L-Aginine showed the most potency against the toxicity. Previous studies (Obidike *et al*., 2023) showed that antioxidants protect the kidney by preserving vascular structure and microcirculatory flow via maintenance of $Fe_2^+$and Cu^+ containing hydroxylase and monooxygenase enzymes. Monoxygenases are essential in collagen and vasopressin synthesis central to vascular structure and functionality, and also modulate redox activated signaling pathways, such as HIF-1, down-regulating genes involved in pro-inflammation (Dennis and Witting, 2017).

Toxicity of the kidney is characterized by alteration in the electrolyte balance usually due to alteration in the transporters (Na^+/K^+ transporter or Na^+/H^+ transporter) involved in the homeostasis of the electrolytes (Nakaj *et al*., 2023). The disruption noticed in the electrolyte concentrations of the group 4 is indicative of renal toxicity while the normalization seen in the results of the treated groups is indicative of improved renal function and architecture implicative of reversal of the toxicity caused by the toxicant.

Furthermore, the higher SOD and GPx activities seen in the L-Arginine group could imply that L-Arginine has better antioxidant activity and could ameliorate the complications attributed to diabetes mellitus-induced oxidative stress
Increased oxidative stress burdens the CAT activity and results in reduced enzyme activity which is implicated in diabetic nephropathy (Shabalala *et al.* 2022). This depletion of the antioxidant enzymes contributes to increased oxidative stress and may play a crucial role in the pathogenesis and progression of diabetic nephropathy disease (Khalid *et al*., 2018). The increase in the CAT activity in the L-Arginine group and L-Glutamate group when compared to the diabetic group could be indicative of improved antioxidant activity and could reduce the toxicity attributed to diabetes mellitus-induced oxidative stress. Once more, the L-Arginine group showed higher CAT activity compared to the L-glutamate group and the group co-treated L-Arginine and L-glutamate. The higher CAT activity seen in the L-Arginine group could imply that L-Arginine has better antioxidant activity and could ameliorate the complications attributed to diabetes mellitus-induced oxidative stress compared to L-glutamate.

A consistent biomarker for oxidative stress is malondialdehyde (MDA), a byproduct of lipid peroxidation (Modawe *et al*., 2023).Diabetes complications are ultimately caused by oxidative stress-induced cell damage (Jiang *et al*., 2023). The reduced MDA concentration seen across the treatment groups is indicative of reduced lipid peroxidation hence, improved antioxidant potential of the treatment supplements. However, the lowest peroxidation as seen in the L-Arginine group is indicative of very high anti-peroxidation property which is expected due to the high antioxidant activity expressed by the supplement.

CONCLUSION

From the study above, it could be concluded that L-Arginine and L-glutamate both have the supplements have showed hepato-protective and reno-protective potentials while also indicating hematological stabilizing properties. However, it could be better concluded that L-Arginine showed higher ability to reverse the toxicity induced by Streptozotocin compared to L-Glutamate, Though Glibenclamide shows potentials of the same effect but continual use of the supplement will show a better potential.

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