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Full Length Research Article

EFFECTS OF *SOLANUM MACROCARPON* ON LIVER SYNTHETIC ABILITY, LIPID PROFILE, SPLEEN AND HEART HISTOPATHOLOGY IN PHENYLHYDRAZINE-INDUCED HEMOLYTIC ANEMIC RATS

[1*] Usunomena U., [2]Amenze I. O., [3]Adegbegi A., and [4]Ehigiamusoe A. O.

[1]Department of Biochemistry, Faculty of Basic Medical Sciences, Edo State University
[2]Department of Biological Sciences (Biochemistry unit), Benson Idahosa University
[3]Department of Biochemistry, Faculty of Life Sciences, Ambrose Alli University
[4]Department of Science Laboratory Technology, Rufus Giwa Polytechnic

[*] **Corresponding author:** usunobun.usunomena@edouniversity.edu.ng

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Abstract

Global estimates showed that 43% of children and 33% of non-pregnant women are anemic, with the highest incidence in Africa and South Asia. The aim of this study was to ascertain the effect of *Solanum macrocarpon* aqueous leaf extract on liver synthetic ability, lipid profile as well as spleen and heart histopathology in phenylhydrazine-induced anemic male Wistar rats using five groups of six rats. Group 1 was the normal control, orally given normal saline once daily. Group II was the anemic group, while Group III was non-anaemic and orally given a daily dose of 300mg/kg of *Solanum macrocarpon* aqueous leaf extract for 14 days. Group IV was induced with anemia and thereafter, orally treated with 300mg/kg *Solanum macrocarpon* aqueous leaf extract for 14 days while Group V was induced with anemia and thereafter treated with 100mg/kg Ascorbic acid orally once daily for 14 days. Groups II, IV, and V were intraperitoneally induced haemolytic anemia once daily with 50mg/kg Phenylhydrazine for three days consecutively. All rats were sacrificed on day 15. The study revealed a significant higher (p<0.05) serum total protein (6.72±1.15), albumin (3.42±0.56) and high density lipoprotein (42.20±2.02) as well as significantly lower total bilirubin (1.02±0.14); low density lipoprotein (39.10±3.07), triglycerides (90.25±3.22) and total cholesterol (76.90±3.01) in *Solanum macrocarpon* leaf treated rats compared to the phenylhydrazine anemic-untreated rats. Furthermore, *Solanum macrocarpon* leaf restored pathological changes in heart and spleen tissues near to normal. *Solanum macrocarpon* leaf demonstrated an anti-anemic effect and

improved the impaired liver synthetic ability and altered lipid profile capability associated with Phenylhydrazine-induced anemia.

Key words: Anemia, Histology, Phenylhydrazine, *Solanum macrocarpon*

Introduction

Anemia is a condition characterized by low hemoglobin (Hb) concentration or low red blood cell (RBC) count. Anemia remains a common blood illness, affecting people of different ages all over the world (Ogbe *et al*., 2010). Anemia can lead to many symptoms including pallor, heart failure, depression, retinal damage, and menorrhagia (Ludwig and Strasser, 2001). Long-term anemia induces major problems in the nervous and immune systems (Yokusoglu *et al.*, 2007; Ekiz*et al.,* 2005).

The toxic effect of drugs and chemicals, including Phenylhydrazine, on RBCs remain one of the causes of hemolytic anemia. Phenylhydrazine in the bloodstream reacts with hemoglobin to form an unstable intermediates form, methemoglobin, a form of hemoglobin that cannot bind to oxygen, hence reducing the oxygen-carrying capacity of red blood cells (Shukla *et al.*, 2012). Due to Phenylhydrazine activation of reactive oxygen species (ROS) production, it has been linked to oxidative stress which plays a crucial role in the ageing and apoptosis of erythrocytes, thus inducing hemolysis (Fibach and Rachmilewitz, 2008; Fujii *et al.*, 2021). Phenylhydrazine thus destroys RBC through the overproduction of ROS, which denaturalize hemoglobin, membrane phospholipids and key enzymes implicated in erythrocyte metabolism (Adebayo *et al.,* 2017).

Natural remedies from traditional plants are seen as effective and safe alternative treatments for toxicity due to plants' phytoextracts / phytocompounds rich in natural antioxidants. The World Health Organization (WHO) acknowledges medicinal plants for their abundance of chemical metabolites, which possess therapeutic properties and can serve as crucial components for chemo-pharmaceutical semi-synthesis (Nurhayati *et al.,* 2023). *Solanum macrocarpon,* a member of the eggplant family called Solanaceae is widely used as a vegetable in many countries in West Africa including Nigeria (Sodipo *et al.,* 2012).The leafy part of *Solanum macrocarpon* has been reported to be effective in the treatment of skin disease, infections and sores when applied to the infected areas (Edijala *et al.,* 2005). Generally, the plant has been used as indigenous medicine for the treatment of several ailments such as asthma, allergic rhinitis, nasal catarrh, skin infections, rheumatic disease and swollen joint pains, gastro-oesophageal reflux disease, constipation, dyspepsia and also in weight reduction (Dalziel, 1937).

Phytochemical screenings of *Solanum macrocarpon* leaves detected the presence of flavonoids, alkaloids, saponins, terpenes, glycosides and steroids as well as minerals with health benefits including calcium, magnesium, potassium, sodium, iron, zinc (Usunobun and Igwe, 2016). *In vitro* antioxidant studies on *Solanum macrocarpon* leaves revealed that the higher the concentration, the higher the antioxidant activity, thus the better the free radical scavenging and quenching potentials (Usunobun and Igwe, 2016). It has also been reported and established that *Solanum macrocarpon* leaves maintained liver function enzymes and attenuated oxidative damage and oxidative stress in phenylhydrazine-induced anemic rats

(Usunobun *et al*., 2025). Considering the potentials for numerous health benefits, this study was conducted to ascertain the effect of *Solanum macrocarpon* aqueous leaf extract on liver synthetic ability and lipid profile as well as on heart and spleen histopathology in phenylhydrazine-induced anemic male wistar rats.

Materials and methods

Chemicals used for the research.

Phenylhydrazine was sourced from Sigma Aldrich, and diagnostic kits for biochemical measurements were obtained from Randox Diagnostic Limited, United Kingdom. All other chemicals and reagents were of analytical grade.

Collection, Identification, and Extraction of *Solanum macrocarpon* leaves.

A previous method of Usunobun *et al* (2025) was employed. Fresh leaves of *Solanum macrocarpon* were collected in December 2024 in a garden in Sapele Road, Benin City and authenticated by a taxonomist in the Department of Plant Biology and Biotechnology, Edo State University Iyamho, Nigeria. After being thoroughly washed, leaves were air-dried at room temperature and crushed into fine powder. To prepare the aqueous extract, 1kg of the powdered leaf was soaked in double distilled water (5000ml) and placed for 48 hours at room temperature. Thereafter, filtration was carried out first through a Whatman filter paper No. 42 (125mm) and subsequently through cotton wool. The concentration of the filtrate was done using a rotary evaporator set at 40ºC to one-tenth its volume and thereafter freeze-dried to obtain solid extract used for the study.

Ethical Approval

The Edo State University Iyamho Institutional-Based Research (IBR) Grant committee gave approval (Ref: 001496952203) for this study. The guidelines for ethical conduct in the care and use of nonhuman animals in research as stipulated by the American Psychological Association (APA) were strictly adhered to.

Experimental Animals

Adult male Wistar albino rats (180-200g) were purchased from the Department of Zoology animal house, Ambrose Alli University, Ekpoma, Nigeria and kept in cages at the Animal House of Edo State University Iyamho. They were maintained at room temperature (22±2 °C) with 12hour on/off light. The rats were fed with feed pellets and water. They were acclimatized to laboratory conditions for five days before being divided into five groups.
(2800 Hematology Auto-Analyzer)

Induction of Hemolytic Anemia and Experimental Design

Before the commencement of *Solanum macrocarpon* aqueous leaf extract treatment, the hemolytic disorder was intraperitoneally induced with 50mg/kg phenylhydrazine daily for three consecutive days as previously described by Usunobun *et al.,* (2025). Packed cell volume (PCV) and hemoglobin (Hb) percentage for each rat was determined using a fully automated blood analyser, 2800 Hematology Auto-Analyzer (Ode *et al.,* 2017). Rats with a packed cell volume (PCV) and hemoglobin (Hb) less than 35 % and 10 g/dL respectively, were deemed anemic and included in this study. The five groups of the study, containing six (6) rats each are as follows: Group I (control): normal control (without treatment) was orally given saline once daily. Group II: anemic control (intraperitoneally administered 50mg/kg phenylhydrazine once daily for three consecutive days only) and thereafter received normal saline orally throughout the treatment. Group III: non-anemic rats orally administered 300mg/kg *Solanum macrocarpon* leaf extract once daily for 14

days consecutively. Group IV: anemic rats orally administered 300mg/kg *Solanum macrocarpon* leaf extract once daily for 14 days consecutively. Group V: anemic rats orally administered 100mg/kg Ascorbic acid once daily for 14 days consecutively.

The chosen 300mg/kg extract dosage followed an LD50 study of *Solanum macrocarpon* aqueous leaf extract which showed safety up to 5000mg/kg. All administration was done between 9:00 and 10:00 am each day. All rats were sacrificed 24 hr. after the last extract treatment (day 15) via cardiac puncture/ocular vein and blood was collected in plain tubes (serum) without the use of anticoagulant. The collected blood in plain tubes was centrifuged at 5000rpm after being allowed to stand for 1hr to obtain serum for biochemical analysis.

Tissue collection and preparation of homogenates

Immediately after the animals were sacrificed, the spleen and heart were removed, rinsed with normal saline, and weighed. The collected tissues were fixed in 10% formalin (4% formaldehyde) for pathological assessment.

Determination of Biochemical Parameters

Total proteins, albumin and total Bilirubin were spectrophotometrically determined in serum using commercially available kits according to the manufacturer's instructions (Randox®, Randox Labs, UK). High-Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Total Cholesterol (TCHOL), Triglycerides (TRIG) were assessed using Randox test kits according to the manufacturer's instructions.

Histopathological analysis

Immediately after sacrifice, the spleen and heart of both the test and control rats were excised and dried with blotting paper and a portion was instantly inserted in 10% phosphate-buffered formalin. Fixed tissue samples were placed in paraffin blocks and 5mm sections were prepared. Sections were hematoxylin and eosin (H&E) stained and examined using a light microscope. There was capturing of spleen and heart Photomicrographs.

Statistical analyses

Obtained data (in triplicates) were expressed as mean ± standard deviation. Differences between the groups were determined with ANOVA and Tukey's post hoc test using Graph Pad Prism software. Values are regarded as significantly different at $P < 0.05$.

Results

Phenylhydrazine induced a significant ($p<0.05$) increase in serum concentration of total bilirubin when compared to control and *Solanum macrocarpon* leaf extract treated animals as shown in Table 1. However, the deleterious effects of phenylhydrazine were significantly ($P<0.05$) alleviated towards normal levels (0.46±0.11) in the control experiment, by treatment with either 100mg/kg ascorbic acid or 300mg/kg *Solanum macrocarpon* leaf extract compared to the phenylhydrazine-induced anemic group. There was also a significant decrease ($P<0.05$) in concentration of serum total protein and albumin in the phenylhydrazine-induced anemic rats which were however significantly attenuated ($p<0.05$) towards normal levels in the control experiments (10.04±2.12 and 4.75±1.01 respectively), following administration of 300mg/kg of *Solanum macrocarpon* or 100mg/kg of ascorbic acid to anemic rats for fourteen days as shown in Table 1.

Table 1: Effects of *Solanum macrocarpon* aqueous leaf extract on Liver Synthetic Ability in phenylhydrazine-induced anemic Wistar rats

Treatment groups	Total Protein(g/dl)	Albumin (g/dl)	Total Bilirubin (mg/dl)
Control	10.04^{a}±2.12	4.75^{a}±1.01	0.46^{a}±0.11
PHZ (anemic control)	4.11^{b}±0.97	2.14^{b}±0.25	2.35^{b}±0.94
S. macrocarpon (300 mg/kg) alone	9.35^{a}±1.03	5.55^{a}±1.06	0.62^{a}±0.13
PHZ + *S. macrocarpon* (300 mg/kg)	6.72^{c}±1.15	3.42^{c}±0.56	1.02^{c}±0.14
PHZ + Ascorbic acid (100mg/kg)	7.14^{c}±1.12	3.96^{c}±0.64	1.05^{c}±0.20

Values are expressed as Mean ± Standard Deviation. Values with different superscripts down the column differ significantly (p<0.05). PHZ=Phenylhydrazine

The result in Table 2 depicts the effects of *Solanum macrocarpon* aqueous leaf extract on serum lipid profile in phenylhydrazine-induced hemolytic disorder in albino rats. The result showed a statistically significant (P<0.05) increase in serum cholesterol, triglyceride, low-density lipoprotein (LDL) and a decrease in serum high-density lipoprotein (HDL) in the anemic rats that received phenylhydrazine compared to the normal control and *Solanum macrocarpon* administered rats. However, phenylhydrazine-induced anemic rats administered *Solanum macrocarpon* showed a significant improvement in reducing cholesterol (76.90±3.01), triglycerides (90.25±3.22) within the normal range. LDL (39.10±3.07) and HDL (42.20±2.02) although not within normal range was equally significantly improved when compared to anemic rats that were not treated.

Table 2: Effects of *Solanum macrocarpon* aqueous leaf extract on Lipid profile in Phenylhydrazine-induced anemic Wistar rats

Treatment groups	TG (mg/dl)	TCHOL (mg/dl)	LDL(mg/dl)	HDL(mg/dl)
Control	88.80^{a}±3.25	77.30^{a}±5.71	19.35^{a}±3.11	52.95^{a}±3.01
PHZ (anemic control)	114.00^{b}±5.02	123.03^{b}±5.21	59.40^{b}±3.28	30.01^{b}±2.52
S. macrocarpon(300 mg/kg) alone	92.70^{a}±3.20	73.45^{a}±2.86	18.90^{a}±3.71	55.22^{a}±3.08
PHZ + *S. macrocarpon* (300 mg/kg)	90.25^{a}±3.22	76.90^{a}±3.01	39.10^{c}±3.07	42.20^{c}±2.02
PHZ + Ascorbic acid (100mg/kg)	94.40^{a}±3.50	84.50^{a}±3.35	35.90^{c}±3.81	40.15^{c}±2.16

Values are expressed as Mean ± Standard Deviation. Values with different superscripts down the column differ significantly (p<0.05). TG: Triglyceride; TCHOL: Total Cholesterol; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein

The result of histopathological examination showed a normal control rat spleen with normal follicles and the presence of normal red pulp, white pulp, splenic and the artery (Plate 1A), while phenylhydrazine-induced anemic rats showed degenerating cells of red and white pulps, lymphocytic necrosis, haemorrhage and aggregated inflammatory cells (Plate 1B). However anemic rats treated with *Solanum macrocarpon* leaf or ascorbic acid showed spleen with improvement and recovery as well as mild haemorrhage (Plates 1D and 1E).

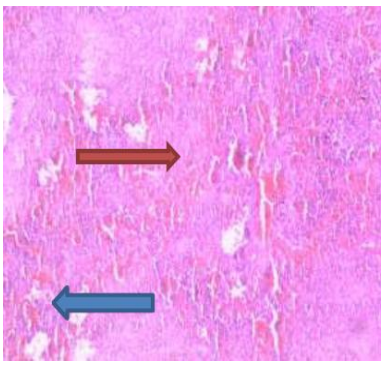
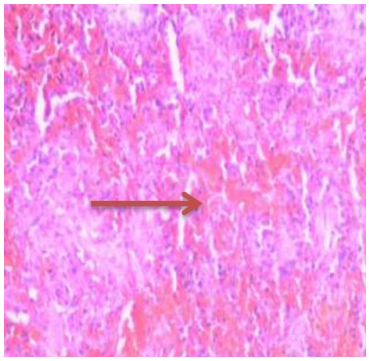
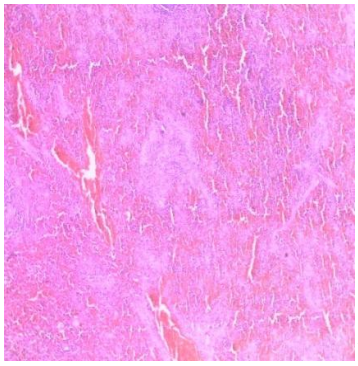
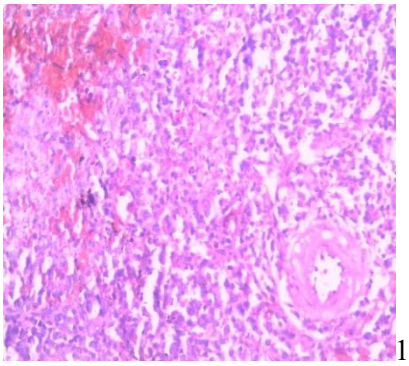
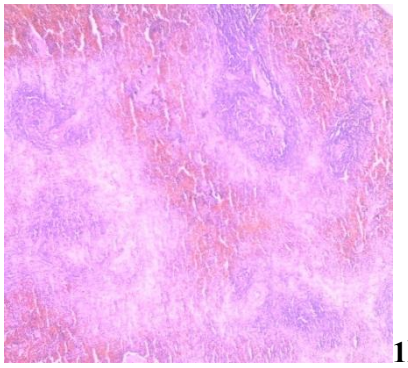

1A

1B

1C

1D

1E

Plate 1A: Photomicrograph of a normal rat spleen showing normal follicles and with presence of normal red pulp, white pulp, splenic and artery.
Plate 1B: Photomicrograph of the phenylhydrazine-induced anemic rat spleen showing degenerating cells of red and white pulps, lymphocytic necrosis, haemorrhage and aggregated inflammatory cells.
Plate 1C: Photomicrograph of non-anemic rat spleen treated with 300mg/kg *Solanum macrocarpon* leaf showing normal follicles
Plate 1D: Photomicrograph of phenylhydrazine-induced anemic rat spleen treated with 300mg/kg *Solanim macrocarpon* leaf showing moderate/mild focal area of haemorrhage change indicating improvement in the spleen
Plate 1E: Photomicrograph of phenylhydrazine-induced anemic rat spleen treated with 100mg/kg Ascorbic acid showing less congested blood vessels and improved spleen tissue.

Histopathological examination of heart revealed control rats with normal heart architecture showing normal heart muscles with normal cardiac myocytes and blood vessel (Plate 2A) while pathological examination of phenylhydrazine-induced anemic rats revealed necrosis of cardiac myocytes, dilated and intramuscular inflammatory cells infiltration (Plate 2B). However, treatment of phenylhydrazine-induced anemic rats with *Solanum macrocarpon* leaf extract or Ascorbic acid showed less inflammation and restoration of the heart features towards normalcy (Plates 2D and 2E).

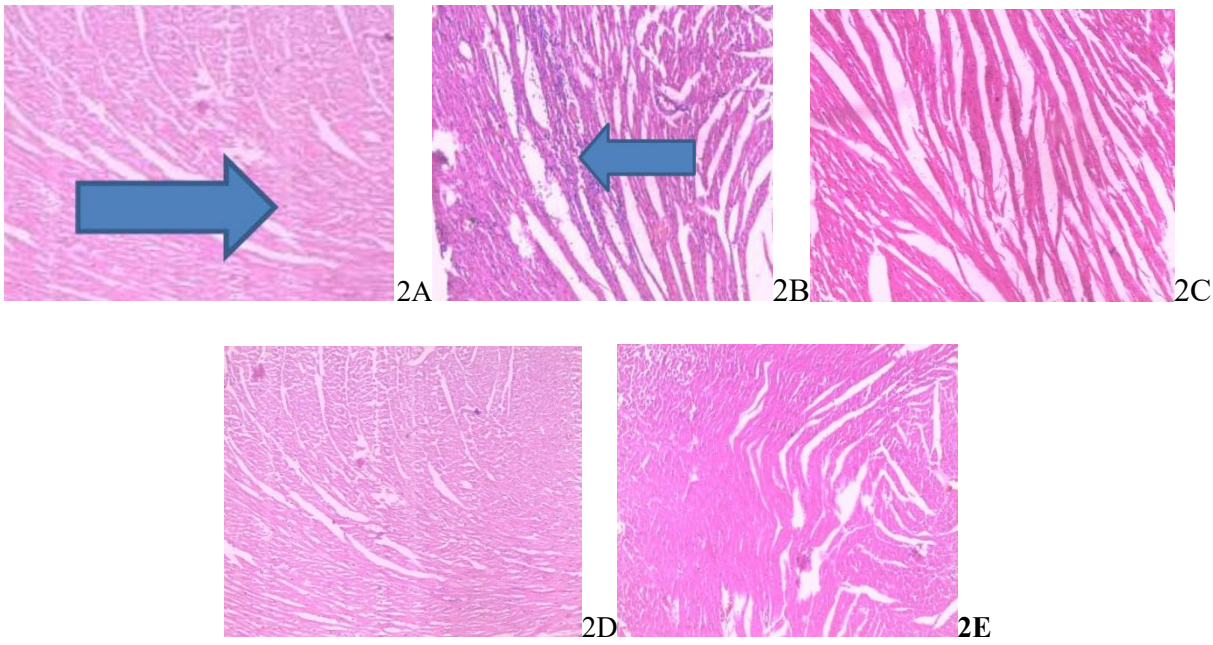


Plate 2A: Photomicrograph of heart of normal rat showing normal heart muscles with normal cardiac myocytes and blood vessel
Plate 2B: Photomicrograph of heart tissue of phenylhydrazine-induced anemic rat showing necrosis of cardiac myocytes, dilated cardiac fibres and intramuscular inflammatory cells infiltration
Plate 2C: Photomicrograph of non-anemic rat heart treated with 300mg/kg *Solanim macrocarpon* leaf extract alone showing normal cardiac myocytes.
Plate 2D: Photomicrograph of phenylhydrazine-induced anemic rat heart treated with 300 mg/kg *Solanum macrocarpon* showing less degeneration and evidence of recovery.
Plate 2E: Photomicrograph of phenylhydrazine-induced anemic rat heart treated with 100mg/kg Ascorbic acid showing healing and less inflammation

Discussion

Biochemical profiling, including estimation of total protein and albumin, is considered a reliable procedure for evaluating liver functionality and liver toxicity. In this study, phenylhydrazine administration caused a noticeable elevation of total bilirubin and decreased serum proteins and albumin, indicating increased liver dysfunctionality similar to previous studies (Usunobun *et al.,* 2020; Usunobun *et al.,* 2024). The observed decreased concentration in serum albumin and total protein indicates a compromised hepatocyte synthetic capacity which is in agreement with previous studies (Zangeneh *et al*., 2019) and Ayoade *et al.* (2020). Moreover, a significant drop in liver proteins may result from malnutrition or liver tissue injury (Sun *et al.*, 2023). The decreased level of total protein may also be an indicator of liver damage due to significant fall in protein synthesis.The decrease in albumin, a protein made by the liver, can indicate impaired liver function as albumin is known to play a crucial role in maintaining blood volume and regulating fluid balance (Van and Joles, 2021). Also the observed decrease in total protein and albumin in phenylhydrazine-induced anemic

rats can be attributed to the destructive effect of phenylhydrazine on the endoplasmic reticulum via the impairment of Ca^{2+} homeostasis, affecting protein biosynthesis (Mekahli *et al.,* 2011). However, there was regeneration of hepatocytes and protein synthesis stimulation following restoration of serum albumin and total protein concentration towards normalcy by aqueous leaf extract of *Solanum macrocarcon* similar to previous works (Usunobun *et al.,* 2020; Usunobun *et al.,* 2024).Treatment with *Solanum macrocarpon* leaf extract protected the liver from the deleterious phenylhydrazine effect by attenuating the decreases in the circulatory levels of total protein and albumin, thus stabilizing the endoplasmic reticulum, an indication that *Solanum macrocarpon* leaf preserved hepatic protein synthetic potential.

Hemolytic anemia and hyperbilirubinemia are closely interlinked with each other as the breakdown of red cells leads to jaundice (hyperbilirubinemia), and hyperbilirubinemia in turn triggers anaemia by inducing death of red cells (Lang *et al*., 2015). In this study, we observed an elevation in serum total bilirubin levels in the phenylhydrazine-induced anemic rats compared with the control and *Solanum macrocarpon* leaf extract-treated rats, which may result from ineffective erythropoiesis, impaired ability of the liver to excrete normal amounts of bilirubin, or obstruction of excretory ducts of the liver (Olaleye *et al.,* 2010). Thus, phenylhydrazine-induced haemolytic anemia and liver injury decrease the liver ability to uptake and conjugate bilirubin for further excretion thereby inducing damage to hepatic bile ducts leading to leakage of bilirubin into the circulation. However, as observed, phenylhydrzine-induced anemic elevations in total bilirubin were significantly decreased following treatment with 300 mg/kg *Solanum macrocarpon* leaf extract similar to previous findings (Usunobun *et al.,* 2020; Usunobun *et al.,* 2024). The decrease in total bilirubin, along with other liver biomarkers to near-normal levels seen in anemic rat administered *Solanum macrocarpon*, suggests a protective effect on hepatocytes. Also, it is possible that the bioactive agents and antioxidant properties of *Solanum macrocarpon* leaf aided hepatocyte recovery from injury and damage by promoting antioxidative and detoxification mechanisms.

Lipid profile is used in the assessment of metabolic defects including dyslipidemia and cardiovascular disease (Faterna *et al.,* 2016). Cholesterol, triglyceride, LDL and HDL cholesterol concentrations are the frequently used indices of lipid profile (Burtis *et al.,* 2008).This study observed that phenylhydrazine at a dose of 50 mg/kg significantly altered the lipid profile, whereas 14 days of administration of *Solanum macrocarpon* aqueous leaf extract mitigated the altered lipid profile in the serum of rats similar to previous studies (Usunobun *et al.*, 2015; Usunobun and Okugbo, 2016; Ezeigwe *et al*., 2019; Usunobun *et al.*, 2023). This observed hypolipidemic effect of *Solanum macrocarpon* leaf can be ascribed to inhibition of pancreatic lipase, essential for fat digestion, and HMG-CoA reductase, a key enzyme in cholesterol synthesis, leading to reduced cholesterol levels (Igbal *et al.,* 2015). Additionally, *Solanum macrocarpon* administration significantly elevated HDL-C levels by suppressing the SR-BI receptor, known to stimulate HDL production (Bietrix *et al.*, 2006). The decline in LDL levels after *Solanum marcrocarpon* administration may be ascribed to protection of hepatic LDL-R genes, enhancing the clearance of LDL from circulation and lowering blood LDL levels (Onwe *et al.,* 2015). Cholesterol is a better focus of interest and concern than the

triglycerides because of its relationship to atherosclerosis, high blood pressure, dementia, angina, and xanthomas. Serum levels of LDL correlate strongly with atherosclerosis and the attendant risk of life-threatening cardiovascular diseases, including coronary artery disease, myocardial infarction, chronic organic brain syndrome, cerebral vascular accidents, thrombosis and embolism, and other thromboembolic disorders (Fernández-Friera *et al.*, 2017; Kolawole *et al.*, 2023). HDL functions independently of the other lipoproteins as it originates in the liver and intestines, binds cholesterol preferentially and triglycerides secondarily, and facilitates the clearance and degradation of these lipids by the liver (Kolawole *et al.,* 2023). In sharp contrast to LDL, the levels of HDL correlate inversely with the risk of atherosclerosis (Kjeldsen *et al.*, 2022). Elevated levels of triglycerides may also lead to pancreatitis, eruptive xanthomas, hepatosplenomegaly, lipemiaretinalis, hyperuricemia, and glucose intolerance (Berberich and Hegele, 2022; Kolawole *et al.,* 2023). Our observed significant increase in HDL level and significant reduction in LDL, total cholesterol and triglycerides levels in *Solanum macrocarpon*-treated anaemic rats when compared with untreated anemic rats can thus be ascribed to the anti-anemic and hypolipidemic effect of the *Solanum macrocarpon* leaf.

Phenylhydrazine poisoning results in erythrocyte oxidative damage, which leads to hemolytic anemia with involvement of the spleen and liver. It results in progressive hematological changes, inflammatory mediators, and enhanced red cell apoptosis because it destroys the cell membrane (Nabil *et al.* 2024). Phenylhydrazine has been reported to produce lipid peroxidation in the spleen, kidney, and liver. Additionally, after phenylhydrazine intoxication, it has been shown that oxidative stress-induced hemodynamic disruption, vascular dysfunction, and electrolyte derangement take place (Hassan *et al.,* 2016; Nabil *et al.*, 2024). As observed in this study, histopathological examination of normal control rat spleen revealed normal follicles with the presence of normal red pulp, white pulp, splenic and artery, (Plate 1A) whereas a critical look of phenylhydrazine-induced anemic rats showed degenerating cells of red and white pulps, lymphocytic necrosis, haemorrhage and aggregated inflammatory cells (Plate 1B) similar to findings of Nabil *et al.* (2024) which reveals a significant number of necrotic cells, haemorrhage, and sporadic apoptotic cells.. However *Solanum macrocarpon* leaf administration for two weeks modulated the alterations observed in phenylhydrazine-induced anemic rats, as there was moderately restored cellularity, preventing phenylhydrazine-induced cell loss as revealed by our histopathology. The pathological observation of necrosis of cardiac myocytes, dilated cardiac fibres, degenerated cardiac muscle, and intramuscular inflammatory cells infiltration seen in heart tissues and the subsequent restoration of the heart features towards normalcy by *Solanum macrocarpon* leaf agrees with previous findings (Sheth *et al.*, 2021).

Conclusion

Solanum macrocarpon leaves consistently continues to demonstrate significant medical benefits in many evaluations attributable to bioactive agents, and this has led and inspired many researchers to conduct additional research on the plant. In this present study, phenylhydrazine administration resulted in impairment in splenic and heart morphology, which was mitigated by *Solanum macrocarpon* leaf. Aqueous leaf extracts of *Solanum macrocarpon* showed protective effects against phenylhydrazine-induced toxicity, as it exerted liver synthetic ability and

improved lipid profile and could thus be used to manage lipid abnormalities associated with anemia. Further investigations are needed to characterize the bioactive compounds responsible for *Solanum macrocarpon* leaf actions.

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Conflict of interest
The authors declare no conflict of interest

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