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Antidiabetic and Histopathological Effects of Two Herbal Formulations on Albino Wistar Rats

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ABSTRACT

This study evaluated antidiabetic and histopathological effects of two herbal formulations 'B-Gludecon' and 'B-Glupocon' on streptozotocin-induced diabetic rats (40 mg/kg/b.wt.). Sixty-six Wister albino rats were placed into eleven cages containing 6 rats per cage, and fasted for 12 hours before induction of diabetes. The diabetic rats in groups A-C were orally dosed daily with B-Gludecon for 10 days, and those in groups D-F were given B-Glupocon at 250, 500, and 750 mg/kg. Groups G-I rats had the standard drug Metformin at 250, 500, and 750 mg/kg oral doses, in contrast, groups J rats were diabetic without treatment (negative control) and group K rats received distilled water (positive control). The fasting blood sugar levels were determined at the intervals of 72 hours, 144 hours and 240 hours using the Accu-Check glucometer and recorded before sacrifice. The kidney and liver were harvested for histopathological analysis. The results showed that B-Gludecon and B-Glupocon at 500 mg/kg had better significant hypoglycemic effects than metformin ($p \leq 0.05$), lowering the concentration of glucose in the blood by 83.24% and 88.22%, respectively. Histopathological analysis revealed that B-Glupocon was more potent in restoring the architectural distortions of the hepatic and renal tissues observed in the diabetic rats. Conclusively, these findings suggest that B-Glupocon and B-Gludecon may be useful in the prevention and treatment of diabetes, and further investigations are necessary to fully explore their therapeutic potential.

Keywords: B-Gludecon, B-Glupocon; Diabetes; Herbal formulations; Histopathology.

Introduction

Traditional herbal medical practitioners in Ogbomoso, Oyo state, Nigeria, have long been applying various plant-based preparations to treat diverse health conditions. Plants have been invaluable to human health, with many serving exclusively as medicinal resources.[1] The World Health Organization defines a medicinal plant as one containing substances with therapeutic potential or precursors for semi-synthesis.[2,3] Diabetes mellitus, affecting approximately 6% of the global population, raises a great health concern, especially in countries with low income.[4] The International Diabetes Federation estimates that by 2030, 80% of diabetic individuals will reside in developing and developed countries, with China, India in the Asia continent and the United States having the largest affected populations.[5] Conventional diabetes treatment involves hormone therapy or glucose-reducing agent, such as sulfonylureas, alpha-glucosidase and amylase inhibitors. However, adverse effects associated with these treatments have prompted research into alternative therapies with improved safety profiles.[6] About 10 - 25% of hospital patients in the United States experienced adverse drugs reaction, accounting for up to seven per cent of the patients seeking medical attention in the hospitals.[7]

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Herbal medicines for the prevention and treatment of diabetes may act through insulin sensitization. Berberine, Cinnamon, and Ginseng have positive effects on insulin towards glucose level regulation to ensure glycemic control.[8,9,10] Gurmar and turmeric were reported to inhibit alpha-glucosidase, which suppresses carbohydrate digestion to normalise postprandial glucose levels.[11,12] Diabetes associated symptoms, such as oxidative stress and inflammation, were ameliorated by Turmeric and Ginseng.[12,10] *Allium cepa* contains antidiabetic, anti-inflammatory, neuroprotective and antiparasitic effects.[13] *Senna alata* is commonly known as candle bush; its leaves were reported to contain phytochemicals that are anti-inflammatory and hypoglycaemic in actions.[14] Seeds, stem, bark and root of *Garcinia kola* have been reported to ameliorate hyperglycemia and kidney and liver tissues damages common to streptozotocin-induced diabetic rats.[15] In Nigeria, a large percentage of human population depends on plants extracts either singly or in combination to prepare antidiabetic herbal formulation for the treatment of diabetes. This practice is very common among the people of Ogbomoso in Oyo State, Nigeria. Two commonly administered antidiabetic herbal formulations that were investigated in this study contain plants that have been reported to have antidiabetic efficacy[13,14, 15]. Therefore, there is a need to carry out investigation that can scientifically validate the antidiabetic therapeutic claim by the herbal medicine practitioners. Investigation into therapeutic potential of medicinal plants or herbal formulation prepared with these plants may lead to the development of effective, safe, and affordable antidiabetic agents.[16] The search for novel, plant-based antidiabetic agents with reduced adverse effects has become increasingly important.
This study evaluated the antidiabetic potential of traditional herbal formulations, with a view to validating the therapeutic claim scientifically and contributing to the development of safer and more effective therapies.

Materials and Methods

Sample Collection
Two anti-diabetic herbal formulations (liquid and powder forms) were

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investigated in this study. The plant and non-plant materials needed in the preparation of the two herbal formulations were purchased at Jagun market (8.13478^0 N-latitude, and 4.25865^0 E - longitude), Ogbomoso, Oyo State, Nigeria, and they were properly identified in the Herbarium unit of Department of Pure and Applied Biology, LAUTECH, Ogbomoso, by a taxonomist who assigned voucher numbers as follows: *Allium cepa* (LHO 916), *Senna alata* (LHO 917), *Garcinia kola* (LHO 918), *Xylopia aethiopica* (LHO 919), *Piper guineense* (LHO 920), *Syzygium aromaticum* (LHO 921), *Mondia whitei* (LHO 922) and *Plumbago zeylanica* (LHO 923).

Preparation of herbal formulations

The liquid antidiabetic herbal formulation was made with plants and non-plant materials, namely, fresh leaves of *Allium cepa* (9.84 g), 15.52 g *Xylopia aethiopica* (fruit pod), 3.73 g *Piper guineense* (fruit), and 1.83 g *Syzygium aromaticum* (flowers), 38.91 g of African black soap and 6.65 g of edible *camphora*. These constituents were washed thoroughly with distilled water to remove contaminants, boiled with 4 litres of de-ionized water for two hours and filtered. The filtrate was allowed to cool and stored in a sterilized plastic keg for further investigation.[17] The plants materials for making the powdered herbal formulation were *Senna alata* (22.73 g root), *Garcinia kola* (37.2 g fruit), *Mondia whitei* (14.27 g root), *Plumbago zeylanica* (7.33 g root) and *Allium cepa* (7.76 g dry leaves). Each of these plants materials was cut into tiny pieces using a sterilized sharp knife, and they were dried under ambient conditions for two months. Thereafter, the plants materials were ground together into powder using an electric blender whose blades were first sterilized with ethanol before use. The fine powder was sieved using a standard laboratory sieve of 600µm pore size.[18]

Liquid-Liquid and *Solid-Liquid Extraction*

One hundred milliliters of the liquid herbal filtrate was added with 120 ml analytical grade ethanol, and this was vigorously shaken for 30 minutes. The mixture was allowed to stay undisturbed for 60 minutes. The upper layer was removed using a micropipette, and the process was repeated six times for complete extraction.[19] Five grams of the powdered herbal formulation was added with 15 ml analytical grade ethanol, and the mixture was vigorously shaken for 30 minutes, allowed to stand for 60 minutes, and then filtered with the No 1 Whatman filter paper. The process was repeated 6 times for complete extraction.[19] Solvent in the extracts was removed from the liquid and powdered antidiabetic herbal formulations using a rotary evaporator. The obtained sludge was further dried for 4 hours in an oven set at 30^0 C to get powder of the two herbal formulations, which were kept in a desiccator as herbal drug I named 'B-Gludecon' (Blood-Glucose Decoction) and herbal drug II named 'B-Glupocon' (Blood-Glucose powder) for further analysis.

Animal Models

The approval to use animals for this investigation was given by the Faculty of Basic Medical Sciences' Ethical Research Committee, LAUTECH, Ogbomoso, through the Protocol Identification code: ERC/FBMS/069/2024 and Approval number: ERCFBMSLAUTECH:081/11/2024.

Sixty-six albino female Wistar rats of average weight of 150 g were acclimatized for 10 days under ambient conditions of 25 ± 2°C temperature, 45 ± 5% relative humidity and 12 hours light / 12 hours dark cycle during which they had free access to commercial rat pelletized feed and water *ad libitium*. These animals were fasted for 12 hours overnight before the induction of diabetes by injecting streptozotocin at 40 mg/kg/b.wt intraperitonealy after dissolving it in 8 ml of normal saline.[19] The concentration of fasting blood glucose was checked after 48 hours, 96 hours, and 168 hours. To prevent fatal hypoglycemia, the animals were given 5 ml of 10% sucrose solution by oral gavage, thereafter they were given 5% glucose in drinking water for the next 72 hours.[20] After 48 hours, the fasting blood sugar was measured using a glucometer (Accu-Check® Active, Germany, measurement range: 200-600 mg/dL) to determine the amount of glucose in the tail vein's blood. All rats having 200 to 300 mg/dL blood glucose levels were declared diabetic.[18]

Treatment of diabetic rats

In this experiment, rats were grouped A, B, C, D, E, F, G, H, I, J and K having 6 rats in each group. The diabetic-induced animals in these groups were orally administered B-Gludecon (A -C), B-Glupocon (D-F) and Metformin (G-I) at 250 mg/kg, 500 mg/kg and 750 mg/kg suspended separately in 8 ml of distilled water once daily for 10 days (240hours). Group J animals were streptozotocin - induced diabetic rats but not treated (untreated or diabetic group), and Group K animals were non diabetic – induced rats (control) were also administered distilled water orally for 10 days. A glucometer was used to determine the amount of fasting glucose in the tail vein blood of the treated animals. The percentage of blood glucose increase and reduction after induction and after treatment was determined using the formula below:

% of blood glucose increase after induction =

$$\frac{after\ induction - before\ induction}{after\ induction} \times 100$$

% of blood glucose reduction after treatment =

$$\frac{\text{after induction} - \text{after treatment}}{after\ induction} \times 100$$

Histopathological analysis

Rats in the groups A-K were sacrificed on day 11 using chloroform vapour as an anesthesia, their organs (liver and kidney) were harvested and then preserved in 10% formalin for histological studies. These organs were dehydrated progressively in series of ethanol concentrations from 70% to 90%, cleared in xylene and infiltrated with paraffin wax in an automatic tissue processing unit. Sections of 5µm thickness were obtained from the paraffin blocks using a microtome, prepared on microscope slides with egg albumin (sticky substance) and stained with eosin and hematoxylin stains.[21]

Photomicrographs of the liver and kidney sections were taken at ×400 magnification under the light microscope (Olympus) with a digital camera.

Analysis of the obtained data

Statistical analysis was performed on the data to obtain means and standard error, the means were compared and separated in one-way ANOVA, following Duncan's multiple range comparison test. A difference in the mean value of the treatment and negative control groups at $p < 0.05$ was taken to be significant

Results and Discussion

Table 1 shows the effects of B-Gludecon, B-Glupocon, and Metformin on blood glucose level of diabetic rats. B-Gludecon reduced blood glucose by 71.60%, 83.24% and 85.20% at 250, B-Glupocon was able to cause 80.51%, 88.15% and 72.88% blood glucose reduction, and Metformin recorded 82.41%, 60.10% and 68.03% blood glucose reduction all at 250, 500, and 750 mg/kg doses, respectively. The blood glucose of diabetic rats at all doses tested for both B-Gludecon, B-Glupocon, and metformin was reduced significantly ($P < 0.05$). However, B-Glupocon was more effective than B-Gludecon. Interestingly, B-Glupocon performed better in lowering the blood glucose diabetes-induced rats than metformin (the standard drug). B-Gludecon, B-Glupocon antidiabetic herbal formulations contained plants with established traditional medicinal uses.[22,23] Our findings demonstrate that these formulations exhibit significant hypoglycemic effects, renoprotective, and hepatoprotective properties, underscoring their potential as alternative or complementary therapies for diabetes management. Bioactive phytochemicals such as flavonoids, alkaloids, and hydroxycitric acid in B-Gludecon and B-Glupocon may be responsible for their antidiabetic and renal and hepato-protective effects recorded in this study. These bioactive compounds have been reported to modulate insulin signaling pathways, enhance glucose uptake, and inhibit carbohydrate metabolism.[24,25]. The significant hypoglycemic activity of the herbal formulations as well as their renal and hepatic

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protections in the treated rats support this notion. Notably, B-Glupocon demonstrated superior efficacy compared to B-Gludecon and Metformin, as evidenced in complete restoration of kidney and liver architectural morphology at higher doses. This suggests that B-Glupocon may possess unique bioactive compounds or synergistic effects of the plants extracts contained in this herbal formulation which enhance its antidiabetic properties. Further investigation into the phytochemical composition of B-Glupocon may uncover novel therapeutic leads for diabetes management.

Table 1: Effects of B-Gludecon, B-Glupocon and Metformin on blood glucose of diabetic rats

Treatment	Dose (mg/kg)	Before Induction (Mean ± SEM)	After Induction (168 h)	After Treatment (240 h)	% Blood glucose increase after induction	% Blood glucose reduction after treatment
B-Gludecon	Positive Control	75.33 ± 4.80^{a}	75.33 ± 4.80^{a}	75.33 ± 3.80^{a}	–	–
B-Gludecon	Untreated	87.33 ± 4.80^{a}	312.67 ± 33.38^{b}	312.67 ± 33.38^{b}	73.37%	71.66%
B-Gludecon	250	81.00 ± 4.80^{a}	304.17 ± 33.38^{b}	86.20 ± 12.47^{a}	73.37%	71.66%
B-Gludecon	500	81.67 ± 4.80^{a}	367.00 ± 36.57^{b}	61.50 ± 2.99^{a}	77.75%	83.24%
B-Gludecon	750	83.00 ± 4.80^{a}	321.00 ± 33.38^{b}	47.50 ± 2.95^{a}	74.14%	85.20%
B-Glupocon	Positive Control	75.33 ± 5.10^{a}	75.33 ± 34.52^{a}	75.33 ± 6.99^{a}	–	–
B-Glupocon	Untreated	87.33 ± 5.10^{a}	312.67 ± 34.52^{b}	312.67 ± 29.26^{b}	–	–
B-Glupocon	250	78.33 ± 5.10^{a}	395.00 ± 34.52^{bc}	77.00 ± 9.00^{a}	80.17%	80.51%
B-Glupocon	500	88.00 ± 5.10^{a}	464.25 ± 42.28^{c}	55.00 ± 23.00^{a}	81.04%	88.15%
B-Glupocon	750	82.00 ± 5.10^{a}	345.83 ± 34.52^{b}	93.80 ± 12.38^{a}	76.29%	72.88%
Metformin	Positive Control	75.33 ± 6.02^{a}	75.33 ± 25.79^{a}	75.33 ± 6.99^{a}	–	–
Metformin	Untreated	87.33 ± 6.02^{a}	312.67 ± 25.79^{bc}	312.67 ± 29.26^{b}	–	–
Metformin	250	78.33 ± 6.02^{a}	356.40 ± 28.25^{c}	62.67 ± 4.53^{a}	78.02%	82.41%
Metformin	500	78.17 ± 6.02^{a}	262.50 ± 31.58^{b}	104.75 ± 12.33^{a}	70.22%	60.10%
Metformin	750	73.83 ± 6.02^{a}	244.00 ± 25.79^{b}	79.00 ± 12.96^{a}	69.74%	68.03%

Mean value ± SEM (n = 6), mean values with different superscript alphabets along the same column are significantly different $p \leq 0.05$

The results of histopathological studies conducted on the kidneys of diabetes-induced rats that were treated with B-Gludecon and B-Glupocon, and Metformin, positive (uninduced) and untreated rats (diabetic) are shown in Plate A. The histology of the renal tissue of the rats treated with distilled water (control) appeared normal, while that of the induced diabetic rats was distorted. The tissues of the control group's rats had their renal corpuscle with glomerulus having podocytes separated by a well-defined normal-looking Bowman's space. The interstitium was free of congestion. The untreated diabetic rats were found with renal corpuscle with glomerulus having podocytes separated by a widened Bowman's space. There were focal areas of hemorrhagic lesions within the glomerulus and interstitium.

The histology of the renal tissue of the diabetic rats treated with 250 mg/kg of B-Gludecon showed renal corpuscle consisting of glomerulus with podocytes separated by a widened Bowman's space. There were focal areas of hemorrhagic lesions within the glomerulus and interstitium. At 500 mg/kg, the renal corpuscle contained glomerulus with podocytes and separated by a well-defined normal-looking Bowman's space. However, there was a focal area of interstitial hemorrhage. The diabetic rats administered with 750 mg/kg B-Gludecon had renal corpuscle that revealed glomeruli with podocytes, having separated well-defined normal-looking Bowman's space, and interstitium without congestions. The renal tissues of diabetic rats administered with 250 mg/kg, 500 mg/kg and 750 mg/kg B-Glupocon revealed renal corpuscle consisting of glomeruli with podocytes, having separated well-defined normal looking Bowman's space, and interstitium free of congestions.

The renal tissues of diabetic rats orally dosed at 250 mg/kg, 500 mg/kg and 750 mg/kg metformin (MET) showed renal corpuscle having glomeruli with podocytes separated by a well-defined normal-looking Bowman's space. However, 250 mg/kg had a focal area of interstitial hemorrhage. The interstitium in the vascular tissues exposed to 500 mg/kg and 750 mg/kg was found congested. Plate B shows the effects of streptozotocin, distilled water, B-Gludecon, B- Glupocon and Metformin on the hepatic tissue of the diabetic rats. Hepatic tissue of the control displays the normal features. The liver cells contain vesicular nucleus and have polygonal shape. The sinusoids which separated them have thin endothelial lining without inflammatory cells. They have normal central vein. For the untreated diabetic rats, the hepatic tissue appeared abnormal. The cell is polygonal in shape with reduced chromatin materials in its nucleus. In between the cells were sinusoids that appear narrowed, while the focal areas have vascular congestion. The hepatic tissue of the rats administered with 250 mg/kg B-Gludecon was morphologically affected. The cells have polygonal shape with vesicular nucleus that is well-outlined. They were separated by thin endothelial lining-sinusoids. They have vascular congestion in the focal areas. The hepatic tissue exposed to 500 mg/kg and 750 mg/kg was normal. There were polygonal hepatocytes containing distinct vesicular nuclei. Sinusoids separating the cells were with thin endothelial lining, they were free from collections and inflammatory cells. The hepatic tissue of the rats dosed at 250 mg/kg, 500 mg/kg and 750 mg/kg of B- Glupocon displayed normal morphological architecture. They have cells with polygonal shape, containing a distinct (well-outlined) vesicular nucleus.

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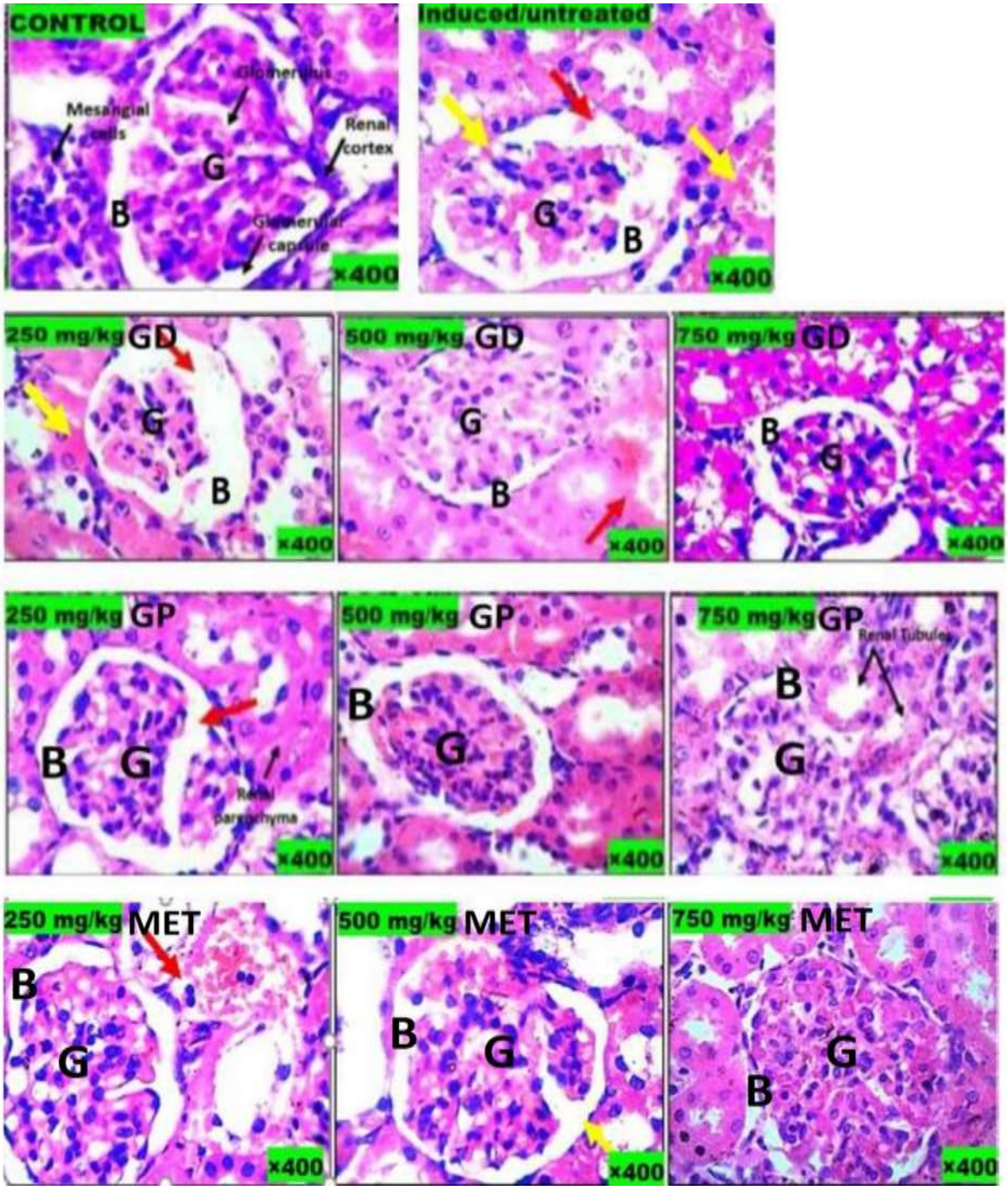

Plate A: Histology of the renal tissue of rats treated with distilled water (control), streptozotocin (untreated or diabetic rats), Gludecon and Glupogon (antidiabetic herbal formulation) and Metformin (standard antidiabetic drug) (H&E, Mag.: 400 x) Control -*The renal tissue of the control appears normal, the renal corpuscle consists of glomerulus (G) containing podocytes and separated by a well-defined normal-looking Bowman's space (B). The interstitium is free from congestions* Untreated - *The renal tissue of the untreated diabetic rat appears distorted. The renal corpuscle consists of glomerulus (G) containing podocytes and separated by a widened (red arrow) Bowman's space (B). There are focal areas of hemorrhagic lesion (yellow arrow) within the glomerulus and interstitium.* B-Gludecon (GD) (250 mg/kg) - *The renal tissue shows renal corpuscle consisting of glomerulus (G) with podocytes and separated by a widened (red arrow) Bowman's space (B). There are focal areas of hemorrhagic lesion (yellow arrow) within the glomerulus and interstitium.* B-Gludecon (GD) (500 mg/kg) - *The renal tissue shows renal corpuscle consisting of glomerulus (G) with podocytes and separated by a well-defined normal-looking Bowman's space (BS). The focal area of interstitial is hemorrhagic (red arrow).* B-Gludecon (GD) (750 mg/kg) - *The renal tissue shows renal corpuscle consisting of glomerulus (G) with podocytes and separated by a well-defined normal-looking Bowman's space (BS), the interstitium is free from congestions* B-Glupocon (GP) (250 mg/kg, 500 mg/kg and 750 mg/kg) - *The renal tissue shows renal corpuscle consisting of glomerulus (G) with podocytes and separated by a well-defined normal-looking Bowman's space (B). The interstitium is free from congestions.* MET (250 mg/kg) - *The renal tissue shows renal corpuscle consisting of glomerulus (G) with podocytes and separated by a well-defined normal-looking Bowman's space (B) with focal area of interstitial hemorrhage (red arrow).* MET (500 mg/kg, 750 mg/kg) *The renal tissue shows renal corpuscle consisting of glomerulus (G) with podocytes and separated by a well-defined normal-looking Bowman's space (B), that is free from congestions (yellow arrow)*

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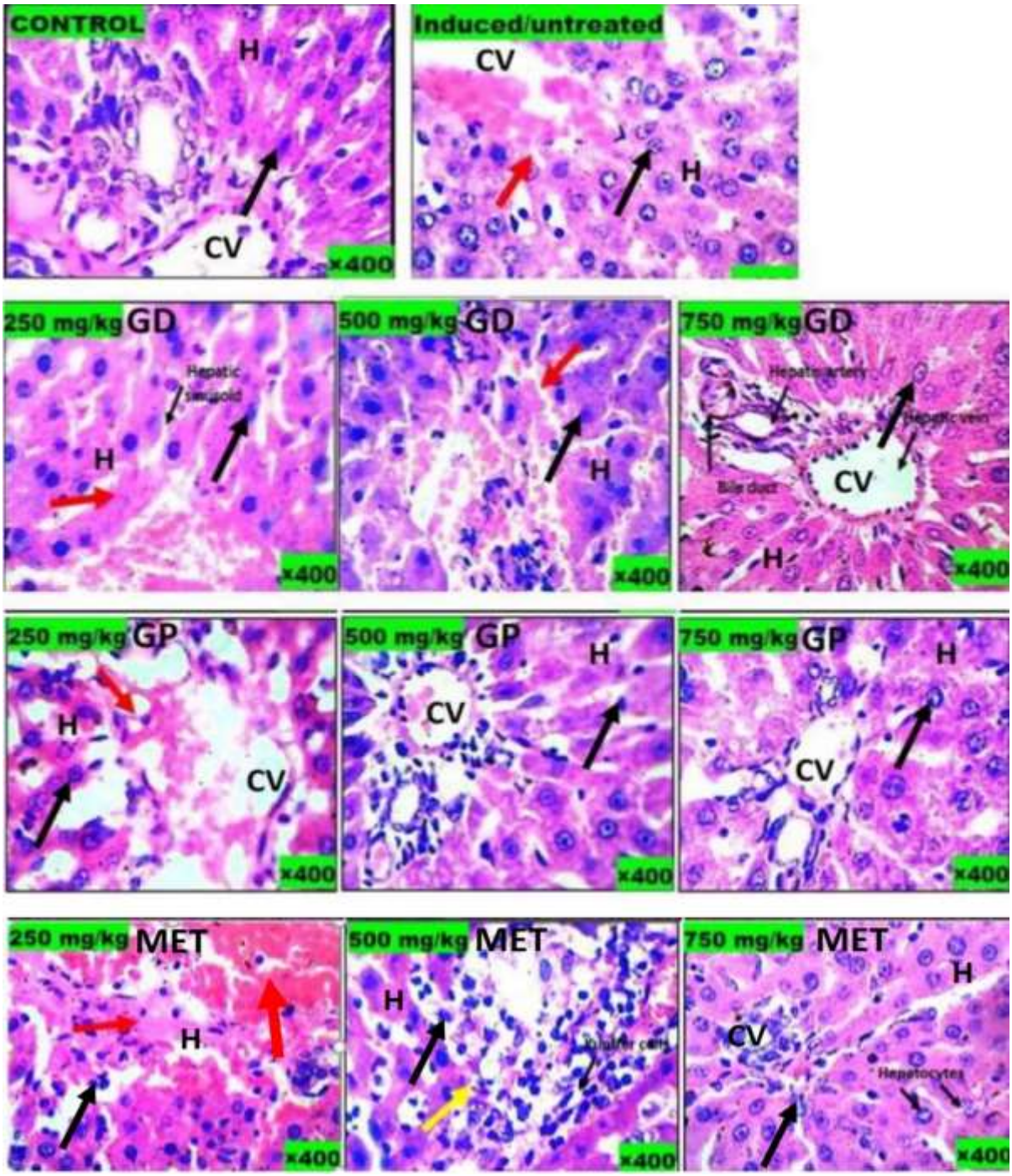

Plate B: Histology of the hepatic tissue of rats treated with distilled water (control), streptozotocin (untreated or diabetic rats), Gludecon and Glupogon (antidiabetic herbal formulation) and Metformin (standard antidiabetic drug) (H&E, Mag.: 400 x) **Control** - *The hepatic tissue appears normal, the hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow), and are separated by the sinusoids with thin endothelial lining, free from collections and inflammatory cells. The central vein (CV) also appears normal*. **Untreated -** *The hepatic tissue appears distorted. The hepatocytes (H) appear polygonal with nucleus with reduced chromatin materials (black arrow), separated by the sinusoids that appear narrowed. There is a focal area of vascular congestion (red arrow).* **B-Gludecon (GD) (250 mg/kg) -** *The hepatic tissue appears distorted. The hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow). The hepatocytes are separated by the sinusoids with thin endothelial lining. There is a focal area of vascular congestion (red arrow).* **B-Gludecon (GD) (500 mg/kg) -** *The hepatic tissue appears normal. The hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow). The hepatocytes are separated by the sinusoids with thin endothelial lining, free from collections and inflammatory cells.* **B-Gludecon (GD) (750 mg/kg) -** *The hepatic tissue appears normal. The hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow), separated by the sinusoids with thin endothelial lining, free from collections and inflammatory cells. The central vein (CV) also appears normal.* **B-Glupocon (GP) (250 mg/kg, 500 mg/kg, 750 mg/kg) -** *The hepatic tissue appears normal. The hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow), separated by the sinusoids with thin endothelial lining, free from collections and inflammatory cells. The central vein (CV) also appears normal.* **MET (250 mg/kg) -** *The hepatic tissue appears normal. The hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow), they are separated by the sinusoids with thin endothelial lining. There are focal areas of hemorrhagic lesion (red arrow).* **MET (500 mg/kg, 750 mg/kg) -** *The hepatic tissue appears normal. The hepatocytes (H) appear polygonal with well-outlined vesicular nucleus (black arrow), and separated by the sinusoids with thin endothelial lining, free from collections and inflammatory cells (yellow arrow). The central vein (CV) also appears normal.*

The sinusoids separating the hepatocytes have a thin endothelial lining. The hepatic tissue has normal central veins and free from collections and inflammatory cells.
The hepatic tissue of the diabetic rats administered with the selected three doses of Metformin (MET) for this investigation displays normal morphology. The cells with vesicular nuclei were separated by sinusoids containing a thin endothelial lining. However, the hepatic tissue of rats exposed to 250 mg/kg had focal areas of hemorrhagic lesions, unlike that observed in the rats administered 500 mg/kg and 750 mg/kg metformin (MET) that was free from collections and inflammatory cells, having normal central vein.

The histopathological findings of this study corroborate the previous reports of streptozotocin-induced pancreatic damage and renal nephropathy.[26,27] However, treatment with B-Glupocon reversed these effects, indicating its potential to mitigate diabetes-related complications. The renoprotective effects of B-Glupocon may be due to the reported antioxidant phytochemicals of the plant constituents of this antidiabetic herbal formulation, with the potency to prevent oxidative reaction and inflammation in diabetic nephropathy.[28] This is contrast to Metformin, which is often associated with undesirable effects such as diarrhea and lactic acidosis.[29] This highlights the potential benefits of herbal formulations as alternative therapies for diabetes management, particularly in resource-limited settings where access to conventional medications may be restricted. The results of this study also underscore the importance of considering the roles of traditional medicines in diabetes management.[30,31,32] Herbal formulations such as B-Gludecon and B-Glupocon may offer a culturally acceptable and affordable alternative to the conventional therapeutics, particularly in the parts of the world where herbalism or use of traditional medicines is greatly accepted in their cultural practices.

Conclusion

The obtained data in this study affirm the antidiabetic potential of the herbal formulations B-Gludecon and B-Glupocon prepared in liquid and powdered forms. The bioactive compounds present in these formulations exhibited significant hypoglycemic effects in diabetic albino rats, substantially reducing the mean fasting blood glucose levels. Notably, B-Glupocon displayed remarkable renoprotective and hepatoprotective properties, preserving the cellular architecture and integrity of the kidney and liver tissues in streptozotocin-induced diabetes in rats. These findings suggest that B-Gludecon and B-Glupocon may serve as effective adjunct or alternative therapies for diabetes management, particularly in mitigating diabetes-related renal complications. This study provides compelling evidence supporting the ethno-therapeutic values of these two herbal formulations against diabetes. It also underscores the importance of investigating herbal formulations as a valuable resource for novel antidiabetic prevention and treatment.

Conflict of Interest

The author`s declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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