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EFFECTS OF *Senna occidentalis* LEAF SUPPLEMENT ON BLOOD GLUCOSE LEVEL, LIVER ENZYMES AND TOTAL PROTEIN IN ALLOXAN-INDUCED DIABETIC WISTAR RATS

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ABSTRACT

*Diabetes mellitus is one of the most common non communicable diseases around the world and is responsible for many deaths resulting from some of its serious complications. Senna occidentalis Linn. is extensively being used in folklore medicine to cure and/or manage many disease conditions, although its adequate validation as therapeutic (specifically anti-diabetic and hepatoprotective) effects has not been established. The aim of this study is to determine the effects of Senna occidentalis leaf supplement on blood glucose level, liver enzymes and total protein in alloxan-induced diabetic wistar rats. Diabetes was induced by single intraperitoneal injection of alloxan (150 mg/kg). Thereafter the rats were fed with Senna occidentalis leaf supplement at doses of 12.5%, 25% and 50%. Also Glibenclamide was used as a standard drug (2 mg/kg) as positive control and diabetic control received distilled water as negative control. Blood glucose levels were measured at day 0, 4, 8, 12 and 16. The liver enzymes and total protein were also determined using the serum and histopathological studies of the pancreas and liver were conducted. Quantitative phytochemical screening revealed that the supplement has high amount of phytoconstituents like total phenols, flavonoids, tannins, saponins and alkaloids, which have a percentage composition of 20%, 10.80%, 15%, 0.55% and 7.20%, respectively. Blood glucose levels of all animals treated with the supplement were reduced significantly ($p < 0.05$) by about 82.13%, 88.36 and 81.78% respectively when compared with that of the untreated diabetic control group. There was also an increase in the total protein ($p < 0.05$) to 90.98 ± 6.02 , 73.72 ± 3.02 and 92.23 ± 4.01 , respectively in comparison to that of the untreated diabetic group having 69.04 ± 3.59 ; and hepatotoxicity due to the observed increase in the activities of all the liver enzymes as well as hepatocellular necrosis, sinusoidal congestion and hemorrhage as revealed in the histopathological studies of the liver. This study shows that *S. occidentalis* leaf supplement has potent hypoglycemic effect due to its high content of active principles that possess strong and potent insulinomimetic and β -cell regenerating potential as depicted by the histopathological studies of the pancreatic tissue, even though, some cytotoxic agents like the cytotoxic saponins may be present in the supplement which is capable of causing damage to both pancreas and liver. These findings prove its use in traditional medicine for the treatment of diabetes but with caution due to its probable potential to induce hepatotoxicity.*

Keywords: Antidiabetic, Hepatoprotective, Hepatotoxicity, Phytoconstituents, Insulinomimetic, *Senna occidentalis*

INTRODUCTION

International Diabetes Federation (IDF) defined diabetes as a chronic metabolic disease characterized by elevated levels of blood glucose (or blood sugar) which over time leads to serious damage to the heart, blood vessels, eyes, kidneys and nerves (IDF, 2006). It is characterized by abnormally elevated levels of blood glucose due to complete or relative insufficiency in insulin secretion and/or insulin action together with chronic hyperglycemia (high fasting sugar level above 126 mg/dl) as well as disturbances in carbohydrate, fat and protein metabolism (Patel and Sharma, 2014). International Diabetes Federation (IDF) and the World Health Organization (WHO) have reported that about 1.5 million deaths are directly attributed to diabetes each year predicting that it will be the seventh leading cause of death in 2030, the world over, and that about 9% of adults in the world have diabetes of

which 90% have type 2 diabetes (IDF, 2006; WHO, 2006). Furthermore, Suleiman *et al.* (2011) reported an estimated increase in diabetes cases of about 38.20% in 2007 when compared to 2002 incidence in Katsina state, Nigeria.

Senna occidentalis is a plant native more to Africa, Asia, and America, and both the leaves and the seeds are used in herbal medicine and belong to the family Fabaceae/Leguminosae. It is a low branching perennial shrub and grows to about three (3) cm feet high (Sadiq *et al.*, 2012). *Senna* has compound leaves with narrow linear-to-oval-shaped dark green leaflets. In the spring and summer it has yellow pea-like flowers which are followed by brown pods which contain brown seeds. Leaves, fruit and flowers of *senna* are used for medicinal purpose (Malviya and Sharma, 2013).

The leaves of *S. occidentalis* Linn were revealed by Adeyemo *et al.* (2014) to contain protein; carbohydrate; fiber; lipids; vitamins; moisture; caloric value and low levels of toxic agents whose levels could be reduced on processing before consumption, and therefore concluded that, the plant can contribute significantly to the nutrient requirements of man and may ameliorate some nutrition related illnesses. In a review by Heme and Latina (2012) the aqueous-ethanolic extract of *Senna occidentalis* (L.) leaves was said to produce significant hepatoprotective and Antidiabetic activities. Onakpa and Ajagbonna (2012) in their study concluded that the results of their study ($p < 0.01$) indicated the presence of active diabetes principles in *senna occidentalis* leaves extract, which seems to confirm its folkloric uses as an Antidiabetic agent. Verma *et al.* (2011) reported that aqueous extract of *s. Occidentalis* exhibited significant antidiabetic activity in alloxan-induced diabetic wistar rats by regeneration of pancreatic β -cells and therefore can be used for diabetic treatment. Rani *et al.* (2010) reported that chrysophanol and the methanolic extracts of the leaves of *senna occidentalis* were able to reduce elevated levels of Aspartate transaminase, Alanine transaminases and alkaline phosphate in Paracetamol – induced hepatotoxicity. This work was designed to evaluate the effects of *Senna occidentalis* leaf supplement on blood glucose levels, liver enzymes and total protein in alloxan-induced diabetic wistar rats.

MATERIALS AND METHODS

Plant Collection and Authentication

Senna occidentalis was obtained from Funtua town of Funtua Local Government, Katsina State. The plant was identified and authenticated at the Herbarium Unit, Department of Biological Sciences, Ahmadu Bello University, Zaria and a voucher number (661) was given and deposited for future reference.

Experimental Animals

Thirty adult male wistar rats weighing 100g to 150g were obtained from the Department of Human Physiology, Faculty of Medicine, Ahmadu Bello University, Zaria, Nigeria. The animals were housed under standard conditions having free access to feed and water *ad libitum*.

Equipment and Chemicals

Distilled Water, One-Touch Digital Glucometer, Digital Weighing Machine, Cages, Syringes (5mls, 2mls and 1ml), Spatula, Set of Dissecting Kit, Normal Saline, Formal Saline, Containers, Pins, Alloxan Monohydrate (purchased from Sigma Chemical Company St. Louis USA).

Diet Formulation

The leaves of this plant were shade-dried at room temperature. The dried leaves were then milled into powder (using mortar and pestle). The powder was combined in different proportions of 12.50%, 25% and 50% to the standard animal diet, and the diet was fed to the diabetic animals for 16 days.

Induction of Diabetes Mellitus

The experimental animals (those to be induced with diabetes mellitus and oxidative stress) were intraperitoneally injected with 150mg/kg of alloxan monohydrate to produce experimental hyperglycemia. After about 72 hours of alloxan injection, animals with fasting blood glucose levels of 180 mg/dL and above were considered diabetic (Mohan *et al.*, 2011).

Experimental Design

The experimental animals were grouped into six groups at random, with each group having five animals ($n=5$). **Group 1:** Normoglycemic rats received normal diet and Normal Saline 10 ml/kg, **Group 2:** Diabetic untreated control rats that received normal diet and Normal Saline 10 ml/kg, **Group 3:** Diabetic Positive Control rats that received normal diet and Glibenclamide 2 mg/kg, **Group 4:** Diabetic rats that received diet containing 12.50% *Senna occidentalis* leaf powder, **Group 5:** Diabetic rats that received diet containing 25% *Senna occidentalis* leaf powder, **Group 6:** Diabetic rats that received diet containing 50% *Senna Occidentalis* leaf powder.

Determination of Blood glucose Level

Determination of blood glucose level was conducted by collecting blood samples from the animal tail vein on a four day interval (starting with day 0 then 4, 8, 12 and 16) for a period of 16 days. A digital One-Touch glucometer was used to monitor blood glucose levels throughout the experiment.

Blood Collection and Tissue Isolation

At the end of 16 days treatment period, the animals were fasted overnight and sacrificed using chloroform as an anesthetic agent. Blood samples were collected via cardiac puncture using 5ml syringes and the serum was used for biochemical assays. The pancreas and the liver tissues of the experimental animals were harvested and fixed in 10% formal-saline solution, and were used for histopathological studies.

Quantitative Phytochemical Screening

Preparation of Fat Free Sample: Sample (2g) was weighed and defatted with 100 mL of diethyl ether using a Soxhlet apparatus for 2 hours. The quantity of each of the following phytochemicals was estimated using standard procedure: alkaloids (Harborne, 1998), flavonoids (Bohm and Kocipai- Abiazan, 1994), tannins (Van-Burden and Robinson, 1981) total phenol (spectrophotometric method) and saponins (Obadoni and Ochuko, 2001)

Assessment of Liver Enzymes

The activities of serum Aspartate Aminotransferase (AST), Alanine Aminotransferase (ALT) and that of Alkaline Phosphatase (ALP) were assayed using colorimetric assay kits (Randox, Northern Ireland) according to manufacturer's instruction and values were expressed in IU/L.

Determination of Serum Total Proteins

Serum total protein were estimated as outlined by Burkhardt and Batsakis (1978).

Histopathological Studies

The harvested pancreas and liver tissues were processed in an automatic tissue processor and sections of 5µ thick were made using leitz base sledge microtome and processed routinely by embedding in paraffin (Gurring, 1992). The sections obtained were stained in haematoxylin for 5minutes and thereafter were placed in eosin for 1 minute. After the staining process, the sections were then washed with tap water, air dried, cleared using xylene and mounted under a light microscope (Cullings, 1993).

Statistical Analysis

Data collected were expressed as mean ± SEM and analyzed using one way analysis of variance, ANOVA, and *Tukey's post-hoc* test was used to compare the level of significance between the control and treatment groups, using SPSS version 20.0. Values of p<0.05 were considered significant.

RESULTS

Phytochemical screening: The result of the phytochemical screening (Table 1) revealed the high concentration of total phenols, tannins and flavonoids, a moderate amount of alkaloids, and a very low amount of saponins.

Effect of the Leaf Supplement on Blood Sugar Level (BSL): Blood glucose levels of all animals treated with the supplement were seen to reduce significantly (p<0.05) by about 82.13%, 88.36% and 81.78% respectively when compared with that of the untreated diabetic control group (Table 2).

Effect of the Leaf Supplement on Liver Enzymes and Total Protein: Table 3 shows that there is an increase in the total proteins in the groups fed with 12.5 and 50% supplements of *Senna occidentalis* (p<0.05) to 90.98 ± 6.02, 73.72 ± 3.02 and 92.23 ± 4.01, respectively in comparison to that of the untreated diabetic group having 69.04 ± 3.59; and slight hepatotoxicity due to the observed increase in the activities of all the liver enzymes.

Table 1: Phytochemical constituents of *Senna occidentalis* leaf supplement.

Phytoconstituents	Percentage Composition
Alkaloid	07.20%
Saponins	00.55%
Tannins	15.00%
Flavonoids	10.80%
Total Phenol	20.00%

Table 2: Effect of *Senna occidentalis* leaf supplement on blood glucose level (mg/dL) in rats

Expt'l Group	BGL Day 0	BGL Day 4	BGL Day 8	BGL Day 12	BGL Day 16
NGR (NC)	68.00 ± 6.25	50.40 ± 2.75	70.60 ± 7.09	63.80 ± 3.87	70.40 ± 3.54
DR (DC) + NS 10ml/kg	430.60 ± 56.14	414.60 ± 80.37	326.40 ± 31.04	324.20 ± 23.06	292.40 ± 25.13
DR (PC) + GBC 2 mg/kg	434.60 ± 53.22	456.80 ± 88.31	315.20 ± 58.20	253.00 ± 70.79	128.80 ± 34.50
DR + 12.5 % SOLS	436.20 ± 52.64	352.20 ± 46.37	300.20 ± 77.40	133.20 ± 51.11*	79.60 ± 13.01*
DR + 25 % SOLS	434.60 ± 60.19	386.00 ± 95.34	231.20 ± 45.52	81.80 ± 13.38*	50.60 ± 13.01*
DR + 50 % SOLS	434.80 ± 70.83	302.60 ± 122.83	210.40 ± 46.52	75.60 ± 7.05*	79.20 ± 5.27*

NGR (NC): Normoglycemic Rats (Negative Control); **DR (DC):** Diabetic Rats (Diabetic Control) + Normal Saline; **DR (PC):** Diabetic Rats (Positive Control) + Glibenclamide 2mg/kg; **SOLS:** *Senna occidentalis* Leaf Supplement; **BGL:** Blood Glucose Level.

*Statistically Significant at p< 0.05 when compared with Untreated Diabetic Control

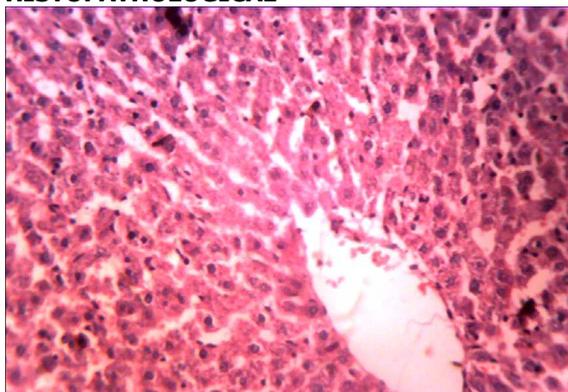
Table 3: Effect of *Senna occidentalis* leaf supplement on liver enzymes (IU/L) and total protein (mg/ml) in rats

Experimental Group	AST	ALT	ALP	Total Protein
NGR (NC)	255.40 ± 17.83	59.64 ± 10.21	277.20 ± 48.97	93.16 ± 3.11
DR (DC) + NS 10ml/kg	345.80 ± 40.15	117.70 ± 23.82	218.00 ± 37.53	69.04 ± 3.59
DR (PC) + GBC 2 mg/kg	244.00 ± 53.48	110.56 ± 32.06	54.40 ± 5.54	77.81 ± 3.73
DR + 12.5 % SOLS	438.40 ± 37.78	80.58 ± 20.04	608.60 ± 243.37	90.98 ± 6.02*
DR + 25 % SOLS	444.00 ± 26.74	146.74 ± 31.43	932.20 ± 200.69*	73.72 ± 3.02
DR + 50 % SOLS	366.00 ± 68.53	121.88 ± 35.85	752.40 ± 155.78	92.23 ± 4.01*

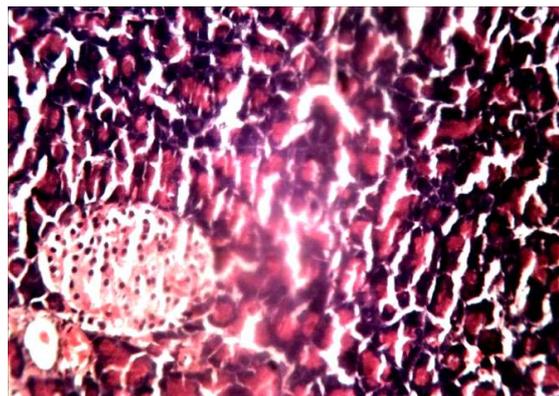
NGR (NC): Normoglycemic Rats (Negative Control); **DR (DC):** Diabetic Rats (Diabetic Control) + Normal Saline; **DR (PC):** Diabetic Rats (Positive Control) + Glibenclamide 2mg/kg; **SOLS:** *Senna occidentalis* Leaf Supplement; **AST:** Aspartate aminotransferase; **ALT:** Alanine aminotransferase; **ALP:** Alkaline Phosphatase.

*Statistically Significant at p< 0.05 when compared with Untreated Diabetic Control

HISTOPATHOLOGICAL



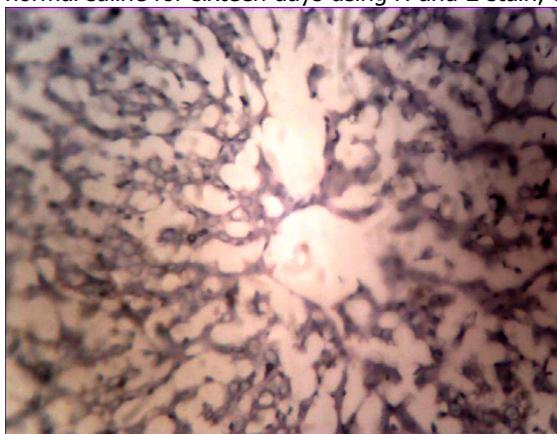
Ia



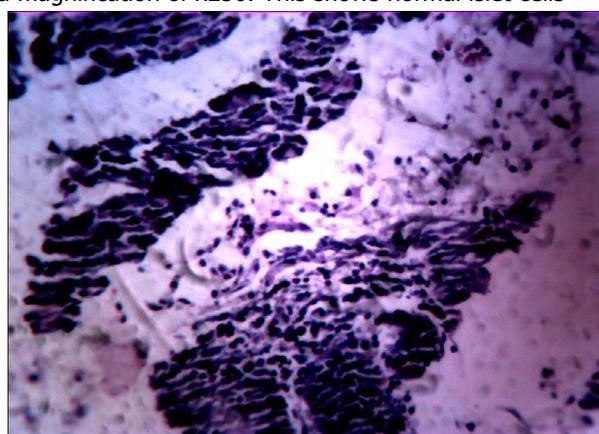
Ib

Plate Ia: Photomicrograph of a section of liver from normoglycaemic wistar rats administered with 2 ml of normal saline for sixteen days using H and E stain; and a magnification of x250. This shows normal hepatocytes.

Plate Ib: photomicrograph of a section of pancreas from normoglycaemic wistar rats administered with 2 ml of normal saline for sixteen days using H and E stain; and a magnification of x250. This shows normal islet cells



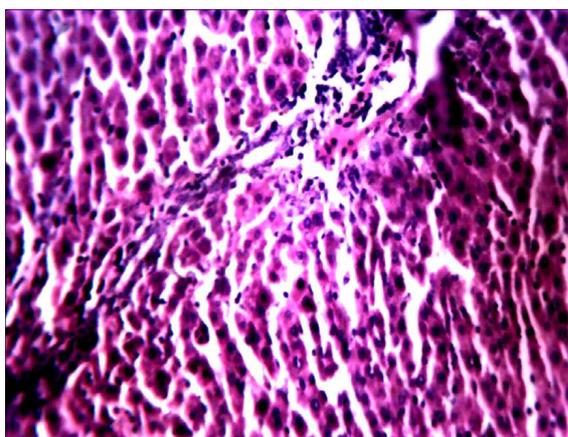
IIa



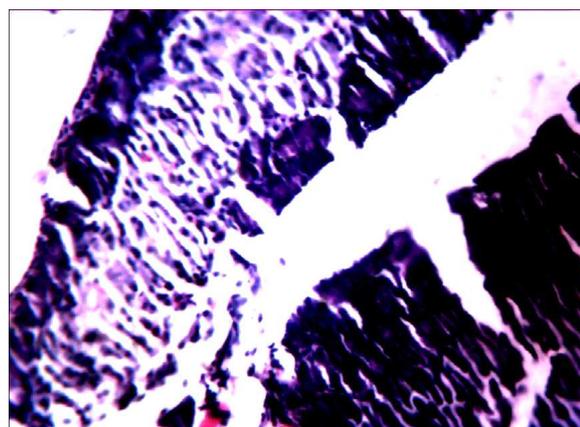
IIb

Plate IIa: Photomicrograph of a section of liver from untreated diabetic wistar rat administered with 2 ml of normal saline for sixteen days using H and E stain; and a magnification of x250. This result shows intense hepatocellular necrosis.

Plate IIb: Photomicrograph of a section of pancreas from untreated diabetic wistar rat administered with 2 ml of normal saline for sixteen days using H and E stain; and a magnification of x250. This result shows intense islet necrosis.



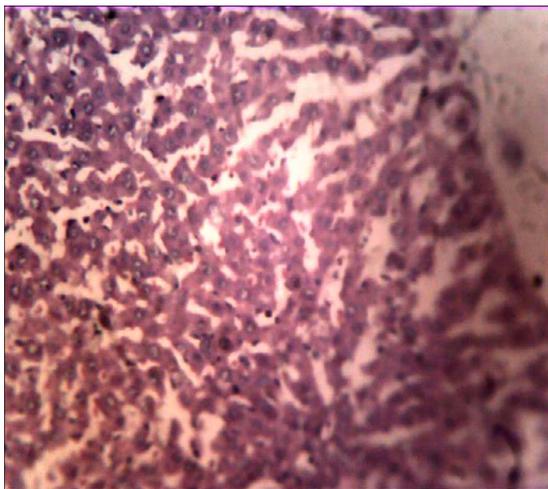
IIIb



IIIa

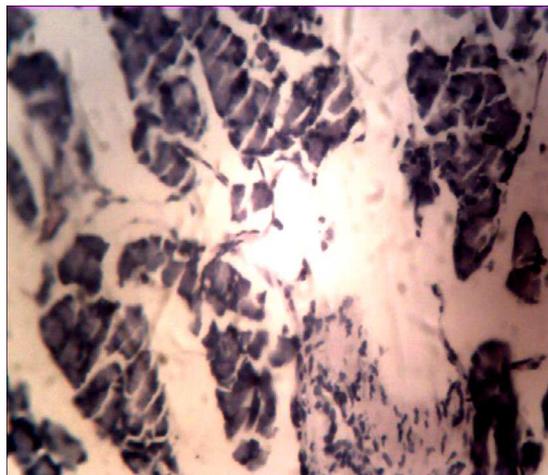
Plate IIIa: Photomicrograph of a section of liver from diabetic wistar rats treated with 2 mg/kg glibenclamide for sixteen days using H and E stain; and a magnification of x250. This shows slight hepatocellular necrosis.

Plate IIIb: Photomicrograph of a section of pancreas from diabetic wistar rats treated with 2 mg/kg glibenclamide for sixteen days using H and E stain; and a magnification of x250. This shows intense necrosis of islet cells.



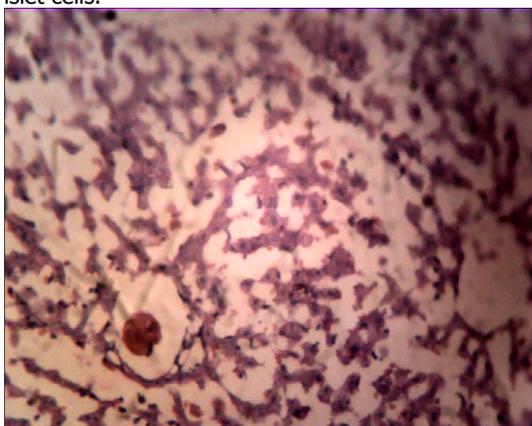
IVa

Plate IVa: Photomicrograph of a section of liver from diabetic wistar rats treated with 12.5% *senna occidentalis* leaf supplement for sixteen days using H and E stain; and a magnification of x250. It shows slight hepatocellular necrosis.



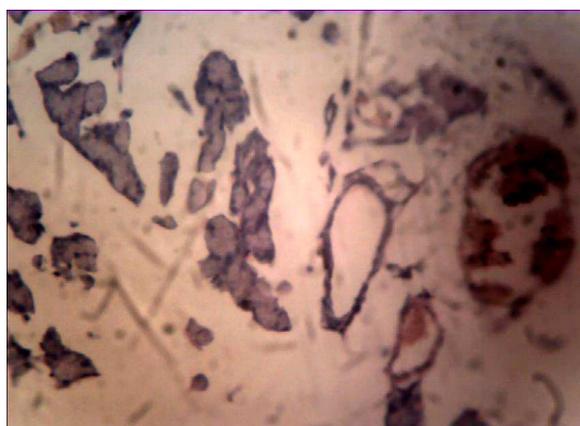
IVb

Plate IVb: Photomicrograph of a section of pancreas from diabetic wistar rats treated with 12.5% *senna occidentalis* leaf supplement for sixteen days using H and E stain; and a magnification of x250. It shows moderate regeneration of islet cells.



Va

Plate Va: Photomicrograph of a section of liver from diabetic wistar rats treated with 25% *senna occidentalis* leaf supplement for sixteen days using H and E stain; and a magnification of x250. It shows moderate hepatocellular necrosis with sinusoidal congestion.



Vb

Plate Vb: Photomicrograph of a section of pancreas from diabetic wistar rats treated with 25% *senna occidentalis* leaf supplement for sixteen days using H and E stain; and a magnification of x250. It shows moderate necrosis of islet cells.

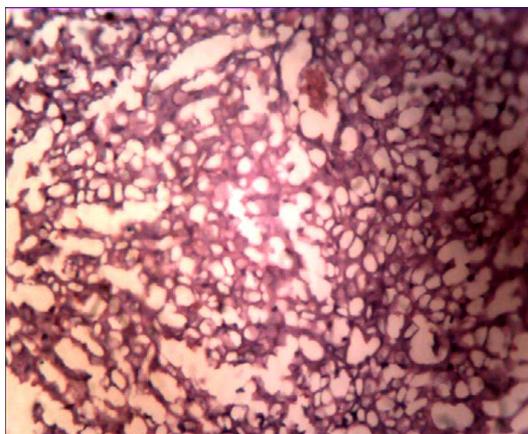


Plate VIa: Photomicrograph of a section of liver from diabetic wistar rats treated with 50% *senna occidentalis* leaf supplement for sixteen days using H and E stain; and a magnification of x250. It shows moderate hepatocellular necrosis.

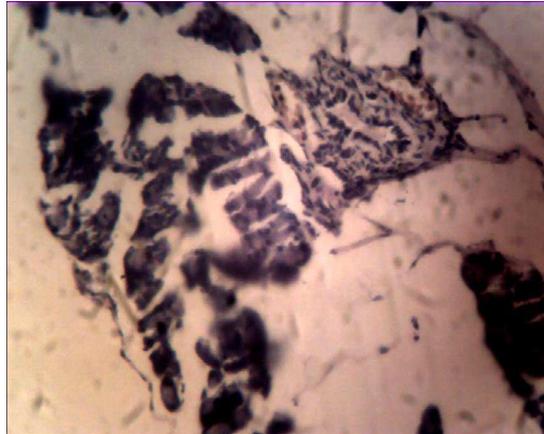


Plate VIb: Photomicrograph of a section of pancreas from diabetic wistar rats treated with 50% *senna occidentalis* leaf supplement for sixteen days using H and E stain; and a magnification of x250. It shows moderate regeneration of islet cells

DISCUSSION

Diabetes mellitus is a metabolic disease associated with impaired glucose metabolism which in effect alters intermediary metabolism of lipids and proteins adversely (Onakpa and Ajagbonna, 2012). Alloxan, a beta cytotoxin, destroys pancreatic β -cells of islets of Langerhans resulting in a decrease in endogenous insulin secretion and paves ways for the decreased utilization of glucose by body tissues leading to elevation of blood glucose level, decreased protein content, increased levels of cholesterol and triglycerides (Lenzen, 2010). This study was conducted to study the effects of *Senna occidentalis* leaf supplement on some biochemical profiles and oxidative stress biomarkers of alloxan-induced diabetic wistar rats. This involves the study of its antihyperglycemic and antioxidant activities in wistar rats as well as to provide an introductory approach for the evaluation of its traditional preparation in order to scientifically validate the therapeutic potential of the leaves of this plant used as supplement in the control of diabetes. In this study, it was observed that alloxan induced diabetic rats that were treated with *S. occidentalis* leaf supplement at doses of 12.5%, 25% and 50% to their feed daily for sixteen days produced significant fasting blood glucose lowering activity in Day 12 and Day 16 dose dependently when compared with the untreated diabetic control, The potency of this effect was seen to be more when compared to that of Glibenclamide as a standard drug. This result is found to be in agreement with that of Garba *et al.* (2015), who reported that various dose levels of the methanolic extracts of *Senna occidentalis* was able to reduce the blood glucose significantly ($p < 0.05$) but however, not dose-dependently. Furthermore, this is in accordance with work of Emmanuel *et al.* (2011), Verma *et al.* (2011) and Singh *et al.* (2011) who reported that the aqueous extracts of the leaves of *S. occidentalis* in male albino Wistar rats has shown a significant hypoglycemic activity. Emmanuel *et al.* (2011) also reported that methanolic extract of leaves exhibited significant reduction in fasting blood glucose levels that was found to be dose dependent. This is also in accordance with the work of Singh *et al.* (2011) who reported that butanol extract of the leaves of *Senna occidentalis* in mice had shown significant antidiabetic activity. The hypoglycemic activity observed could be due to the high phytonutrients content that have been found to be essential in the management of diabetes due to their insulinomimetic, insulin secretagogue, β -cell regenerating and strong antioxidant potentials. The untreated diabetic rats had decreased levels of serum total proteins when compared with the normal negative control rats. Sixteen days supplementation with *S. occidentalis* leaf supplement increased the serum level of total protein significantly ($p < 0.05$). Alloxan induced diabetes leads to elevated levels of liver marker enzymes such as AST, ALT and ALP when compared with normal control rats. Following sixteen days treatment with *Senna occidentalis* leaf supplement, ALT and ALP serum levels were further

elevated even beyond that of the untreated diabetic control although not dose dependently but significantly in the case of ALP when compared with the untreated diabetic control. Thus, animals treated with *Senna occidentalis* leaf supplement can be said to have developed some hepatic damages which was evident from the increase in the enzyme activities as well as histopathological studies of the liver from the *Senna occidentalis* leaf supplement treated groups which shows hepatocellular necrosis with sinusoidal congestion and hemorrhage. But the observed increase in serum total protein level in the *Senna occidentalis* leaf supplement treated groups after sixteen days when compared with the diabetic untreated groups depicts that the severity of the damage to the liver tissue is not much microscopically based on the results obtained, sixteen days supplementation with *Senna occidentalis* leaf supplement may be toxic. This result is not in agreement with the work of Rani *et al.* (2010) who reported that chrysophanol and methanolic extract of leaves of *Senna occidentalis* were able to reduce elevated levels of AST, ALT and alkaline phosphatase when tested in male Albino Wistar rats against PCM – induced hepatotoxicity.

It is also not in accordance with the work of Sastry *et al.* (2011) who reported that the aqueous extract of *S. occidentalis* seeds administered at doses of 100, 200 and 400 mg / kg body weight orally to rats in paracetamol (PCM) - induced hepatotoxicity decreased Paracetamol- induced injuries in rat liver in a dose - dependent manner. But it is however in agreement with the work carried out by Nuhu and Aliyu (2008) who reported that aqueous leaf extract of *senna occidentalis* (Linn.) has hypoproteinaemic effect that it significantly ($P < 0.05$) increased ALT, AST and ALP serum levels, and finally concluded that the crude extract of *S. occidentalis* leaves may be slightly toxic as a concoction for liver ailments. Investigation on the phytochemical compounds of *S. occidentalis* leaf aqueous extract revealed the presence of tannins, phenols, glycosides, cardiac glycosides, triterpene, steroids, carbohydrates, saponins and flavonoids but indicate the absence of anthraquinones. This is quiet in agreement with the results of Mehta *et al.* (2010), Taiwo *et al.* (2013) and Odeja (2014) who worked on various extracts of the leaves of this plant and finally reported the presence of anthraquinones among other active principles. Furthermore, quantitative phytochemical assay of the most important phytoconstituents revealed that *Senna occidentalis* leaf supplement has high quantity of phenols, tannins, flavonoids and alkaloids with saponins as the least in terms of quantity. These phytochemicals are known to be biologically active and thus are thus are responsible for many defence activities of the plant. Phytochemicals exert most of these activities via different mechanisms; tannins for instance act by iron deprivation, hydrogen bonding or specific interactions with vital proteins such as enzymes that bring about its roles as stable and potent antioxidants.

Flavonoid is another phytochemical found in the leaf of *S. occidentalis*; flavonoids exhibit a wide range of biological activities the most important of which is its potent antioxidant and antidiabetic properties like myricetin which is a polyhydroxylated flavonol has been demonstrated to possess insulinomimetic properties, stimulate lipogenesis and transport glucose in the adipocytes, hence lowering blood glucose; and that flavonoids can regenerate the damaged beta cells in the alloxan induced diabetic rats and acts as insulin secretagogue as reported by Geetha (1994). This highlights many of its health promoting functions in organisms, which are important for prevention of diseases associated with oxidative damage of membrane, proteins and DNA, and further supports the usefulness of *S. occidentalis* in folklore remedies and one of the reasons why this plant is widely used for the treatment of many diseases among many tribes in Africa as reported by Hodek *et al.*(2002) and Tasdemir *et al.*(2006). Saponin which is also one of the constituents of *S. occidentalis* is responsible for numerous pharmacological properties. They are considered a key ingredient in traditional Chinese medicine and are responsible for most of the observed biological effects as it is also known to produce inhibitory effects on inflammation as reported by Just *et al.* (1998) and Liu and Henkel(2002). They are also known to reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intraluminal physicochemical reaction hence, it has been reported to have hypocholesterolemic effect and thus its presence in *S. occidentalis* may support its use as an agent for lessening metabolic burden that would have been placed in the liver as reported by Mohan *et al.*(2011). Tannins such as epigallo-catechin-3-gallate, which is one of the phytochemical component of *S. occidentalis*, has been found to exhibit hypoglycemic activity as reviewed by Verma *et al.*(2011). Total phenolic content is very important in plants because of their ability to trap free radicals directly or scavenges them through a series of coupled reactions with antioxidant enzymes due to their hydroxyl

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groups, and thus its presence in *S. occidentalis* endowed it with strong antioxidants potential as reported by Mehta *et al.*(2010). And it has been proved by the literature that there is a positive linear correlation between the total phenolic concentration and the antioxidant capacity some medicinal plants particularly *S. occidentalis* as reported by Verma, *et al.*(2011). Furthermore, several authors like Oliver-Bever (1986) and Rhemann and Zaman(1989) have reported that flavonoids, steroids/terpenoids, phenolic acids are known to be bioactive antidiabetic principles. These observations enumerated on the properties of phytochemicals found in *S. occidentalis* assert its usefulness in traditional medicines and its relevance on folklore medicine in the prevention, treatment and management of infectious and oxidative stress related diseases such as diabetes mellitus and its complication.

CONCLUSION

The results of this study indicates that *Senna occidentalis* leaf supplement possess significant antidiabetic activity, hyperproteinaemic effects and increase in ALT, AST and ALP coupled with the histopathological examinations of the liver tissue were indications that the *Senna occidentalis* leaf supplement may possess both hepatoprotective and cytotoxic effects.

Authors' contributions

This work was carried out in collaboration between all authors. Authors NMG and YT designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author NHS managed the literature searches, analyses of the study performed the spectroscopy analysis. Author AM managed the experimental process. All authors read and approved the final manuscript

Conflict of Interests

Authors have declared that no conflict of interests exist.

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