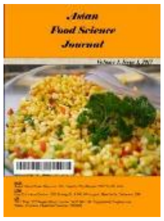

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Yam and *Moringa oliefera* Seed Blend in Lipid Profile Disorders, Kidney and Liver Toxicities, in Alloxan Induced Diabetic Rats

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Authors' contributions

This work was carried out in collaboration between all authors. Author ANK wrote the first draft of the manuscript, performed the statistical analysis and wrote the protocol. Authors JAB and SNI designed the study. Authors ANK, JAB and SNI managed the analyses of the study. Authors ANK and SNI managed the literature searches. Authors ANK, JSA, MOE and ATG edited the study. All authors read and approved the final manuscript.

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ABSTRACT

Background and Aim: Diabetes mellitus is a chronic and very prevalent metabolic disease condition characterized by the abnormally high blood sugar level that eventually gives rise to diabetic complications affecting human and animals. Insulin deficiency increases free fatty acid influx and triglyceride levels into the blood, with reciprocal decrease in high-density lipoprotein (HDL) level. Numerous plants have in the past been screened for antidiabetic effects. Plants with

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medicinal property had served as anti-diabetic In this study; three yam varieties namely *Dioscorea alata, Dioscorea cayennessis* and *Dioscorea rotundata* sourced from Wuruku Market, Benue State Nigeria were evaluated for possible anti-diabetic effects.
Methods: The collected Moringa seeds were processed into flour. *Moringa oleifera* seed 45 male albino rats assigned into 9 groups of 5 rats each were used for the study. Eight groups were induced with alloxan monohydrate and were confirmed to be diabetic after two days before treatment with *Dioscorea alata* control (100%) at 90% + 10% commercial feed, DA90%MRGA10% at (90%) +10% commercial feed, *Dioscorea rotundata* control (100%) at 90+10% commercial feed, DR90%MRGA10%, at (90%) +10% commercial feed, *Dioscorea cayennesis* control (100%) at 90% + 10% commercial. DC90%MRGA10% at (90%) +10%commercial feed, Moringa seed meal (100%) at 90% + 10% commercial feed, and 100% commercial feed. Both GRP8 (non-diabetic group) and GRP 9 (diabetic untreated group), were feed with rat Chow only. At the end of 28dys, the rats were sacrificed and the kidney, liver toxicities and lipid profile disorders were all investigated.
Results: Result generated showed that diabetes caused liver, kidney toxicity and lipid disorder as evidence in the diabetic untreated groups (GRP9).Groups that received yam/moringa seed meal had significantly decreased (P<0.05) triglycerides (TG), cholesterol (Chol), high density lipoprotein-cholesterol (HDL-C) and VLDL and Serum Liver level of aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), Total protein, Albumin, Creatinine and Urea when compared with diabetic untreated group.
Conclusion: A combination of Moringa seed flour and some yam species may be of value in the management of diabetes mellitus and its associated complications.

Keywords: Diabetes; lipid profile; yam species; Moringa oleifera.

1. INTRODUCTION

Diabetes mellitus (DM) is a chronic disease characterized by hyperglycemia resulting from defects in the production, secretion or action of insulin and impaired glucose tolerance. The condition is generally associated with high risk of developing cardiovascular diseases. Diabetes mellitus is also characterized by disturbances in carbohydrate, fat, and protein metabolism due to deficiencies in insulin secretion [1]. Patients with Diabetes mellitus are reported to suffer from liver and kidney disorders because of persistent high blood glucose level with its consequent tissue and vascular damages. These damages are established causes of mortality among diabetics [2]. With hyperglycemia, there is an increased generation of reactive oxygen species (ROS) and development of oxidative stress in most body organs and cells and often results into a further disruption of insulin secretion, β- and endothelial cells function and liver and kidney damage [3]. The liver is a central metabolic organ in the body responsible for regulating and maintaining lipid homeostasis. Insulin deficiency in DM leads to a variety of derangements in metabolic and regulatory processes, which in turn leads to accumulation of lipids in hepatic tissue [4].

Over the counter medicines, currently available for the management of diabetes mellitus have either not yielded desired results or expensive to buy. These drugs which are mostly synthetic have also in recent times raised drug resistance and toxicity concerns. For example, Captopril (the first anti-hypertensive drugs), enalapril and lisinopril as synthetic hypertensive drugs cause effects like a dry cough, taste disturbances and skin rashes. This may be the reason for the current growing global interest in medicinal plants and other natural source medicines [1]. A number of plants have been screened for their medicinal values and usefulness in the management of various ailments including diabetes mellitus [5]. The antidiabetic effects of plants may be attributed to the presence in these plants of phytochemical agents including cardiac glycosides, alkaloids, terpenoids, flavonoids and saponins. Alkaloids and flavonoids are reported to be good antioxidant agents and may be achieving antidiabetic effect via this pathway [6]. Diets rich in phytochemical antioxidants can regulate carbohydrate and lipid metabolism, thereby reducing hyperglycemia, dyslipedemia etc [7]. It is therefore established that the hypoglycemic, hypolipidemic and antioxidant effects of plants are due to flavonoids, ellagic acids, phenolic acids, phytosterols, gallotannins, and other related polyphenols which these plants contain in significant quantities [8].

There exist over 750 species of yam which belong to six genera, namely, *Dioscorea* and *Epipetrum Bordera, Stenomeris, Tamus, Rajania*. The genus *Dioscorea* is tuberous and belongs to the *Dioscoreacae* family. It is largely grown African countries including Nigeria, Ghana, Benin, Côte d'Ivoire, Togo and Ghana, were it is used as staple [9]. These species of yams are also found in Asia and South America . Reports on the phytochemical composition of these yams show that the heavily endowed with alkaloids, tannins, flavonoids, saponins, cardiac glycoside, steroids, anthraquinones and phenolic acids, phenols and bioactive peptides. *Moringa oleifera* has also been reported to be a medicinal plant of high value [10,11]. This study is therefore aimed at evaluating the protective effect of different yam species and moringa seed meal on liver function disorders and kidney and liver toxicities in alloxan- induced diabetic rats.

2. MATERIALS AND METHODS

2.1 Sample Preparation

2.1.1 Preparation of yam flour

Three yam varieties namely; *Dioscorea alata*, (DA) *Dioscorea rotundata* (DR) and *Dioscorea cayennesis* (DC) were purchased from Wurukum Market Benue State Makurdi. The yams were washed, peeled, washed and sliced into 5mm size diameter. This was blanched with 5% sodium metabisulphite at 80°C and was oven dried at the temperature of 60°C for 24 hrs. The dried yam was then ground into flour.

2.2 *Moringa oleifera* Seed Meal

A sample of the plant (*Moringa oleifera* seed) was collected from a local settlement in Umudike, Ikwuano Local Government Area of Abia State and was identified at the Department of Forestry and Environmental Management, Michael Okpara University of Agriculture Umudike Umuahia Abia State Nigeria. A voucher number MOUAU/VPP/17/021 was assigned and a sample was deposited at the herbarium of the Department of Physiology and Pharmacology, College of Veterinary Medicine, Michael Okpara University of Agriculture Umudike Umuahia Abia State Nigeria.

A significant quantity of *Moringa oleifera* seeds was oven dried at 40°C for 12 hours and was milled into fine particles. The milled sample was then transferred into a bottle containing 600 ml of n-hexane. The bottle was placed in a rotator shaker for 48 hours and oil was observed to have moved to the top. The mixture of oil and hexane was then decanted. The meal was collected and dried in the oven at 40°C until all the hexane was evaporated from the cake. The dried cake was then milled to a get a fine powder which was stored in an airtight container until needed.

2.3 Experimental Design/ Feed Formulation

The yam flour was used to form a blend with Moringa (MRGA) seed meal at 10% inclusion. The flour blend was named thus;

(a) *Dioscorea alata* control (DAC) at 100%
(b) *Dioscorea alata* 90% and Moringa seed meal 10% (DA90%MRGA10%),
(c) *Dioscorea rotundata* control (DRC) at 100%,
(d) *Dioscorea rotundata* 90% and moringa meal 10% (DR90%MRGA10%)
(e) *Dioscorea cayennesis* control (DCC) at 100%,
(f) *Dioscorea cayennesis* 90% and moringa meal 10%, (DC90%MRGA10%),
(g) Moringa seed meal (MRGASM) at 100%.

The samples were kept in a safe and dried place and used as animal feed at 90% (yam, moringa seed meal blend) with an addition of 10% rat chow (commercial feed).

2.4 Induction of Diabetes

Forty-five male albino rats (6 weeks old) were obtained from the Veterinary Department of the School of Health, Benue State University Makurdi and were taken to the animal house of the Department of Physiology, Biochemistry and Pharmacology of the College of Veterinary Medicine, Federal University of Agriculture, Makurdi, Benue State Nigeria. The rats were housed in an aluminium cages in a room kept on a 12-hour light-dark cycle and were fed normal chow (Vita FEED, Nigeria) and water *ad libitum*. Acclimatization of the rats took a period of 14 days before the animals were assigned to 9 groups of 5 rats each. Animals in groups 1 to 9 were made diabetic with a single intraperitoneal injection of Alloxan monohydrate (160 mg/kg body weight in 0.05M Citrate buffer, pH 4.5) and were confirmed to be diabetic after 48 hours following single touch blood glucose tests. Animals with blood glucose level 140 mg/dl and above were adjudged to be diabetic and were used for the study. Animals in groups 1-8 were assigned treatment, as appropriate while group 9 was allowed to remain diabetic with no treatment and served as the negative control group. At the end of the treatment, the animals were sacrificed and blood was collected into plain tubes for biochemical analysis. The animal experiments were carried out in accordance with the National Institute of Health guideline for Care and use of Laboratory Animals. Ethical clearance for the work was obtained from the Department of Veterinary Physiology and Pharmacology, Michael Okpara University of Agriculture Umudike, Abia State Nigeria.

2.5 Biochemical Assays

The analyses of the serum lipid profile including triglycerides (TG), cholesterol (Chol),high-density lipoprotein-cholesterol (HDL-Ch).Serum Liver level of aspartate aminotransferase (AST), alanine aminotransferase (ALT), ALP (alkaline phosphatase), Total protein, Albumin. Serum kidney level of Creatine and Ureal were performed using biochemical analyzer (Hitachi Cobass C 311) in the Pathological laboratory of Federal Medical Center Makurdi Benue State Nigeria. Very-low-density lipoprotein cholesterol (VLDL-C) and low-density lipoprotein cholesterol (LDL-C) fractions were calculated as VLDL-C = TG/5 and LDL-C = total cholesterol − (HDL-C + VLDL-C).

Picture 1 shows the Biochemical analyzer (Hitachi Cobass C 311) at the Federal Medical Center Makurdi Benue State Nigeria. Picture 2 shows cage housing some animal during the two week acclimatization period, the picture shows cages housing different groups of the animal

Picture 1.

Picture 2.

Picture 3.

Picture 4.

after being separated into different groups while picture 4 shows the sacrificing of the animals by jugular Venesection at the Necropsy Lab.

3. RESULTS

3.1 Effect of Consumption of Various Yam Species on the Lipid Profile of Diabetic Rats

Total cholesterol value was significantly elevated in the test animals following induction of diabetes mellitus when compared with the normal/un-induced (P<0.05). In the normal control group, total cholesterol value was 1.83±0.10 mmol/L (group 8) while in the diabetic untreated group the value was 2.91±0.15 mmol/L. However, treatment with the various yam species significantly lowered the elevated total cholesterol observed in the diabetic rats when compared with the diabetic untreated group (P<0.05). For groups 1 and 2 treated with DAC and DA90M10, total cholesterol values were 1.71±0.27 mmol/L and 1.83±0.00. Group 3 treated with DCC had a total cholesterol value of 1.92±0.21 mmol/L while those in group 4 treated with DC90M10 total cholesterol value was 2.56 mmol/L. Those in groups 5 and 6 treated with DRC and DR90M10 respectively had total cholesterol values of 1.99±1.55 mmol/L and 2.68 mmol/L. Group 7 treated with MRGA had total cholesterol value of 2.42±0.27 mmol/L (Table 1).

Triglycerides concentration was significantly increased in the diabetic untreated rats (group 9) when compared with the normal control animals (P<0.05). Triglycerides value in the normal control group was 1.02±0.53 mmol/L while in the diabetic untreated group, triglycerides concentration was 1.90±0.89 mmol/L. Treatment with the extract significantly lowered the elevated triglyceride concentration in the diabetic animals (P<0.05). Groups 1 and 2 treated with DAC and DA90M10 had triglyceride values of 0.75±0.25 mmol/L and 0.63±0.00 mmol/L respectively while groups 3 and 4 administered DCC and DC90M10 had 1.75±1.07 mmol/L and 1.24±0.24 mmol/L of triglycerides respectively. In groups 5 and 6 treated with DRC and DR90M10, triglyceride values were 0.65±0.25 mmol/L and 0.65±0.04 mmol/L respectively. For diabetic animals treated with MRGA, triglyceride concentration (0.88±0.17 mmol/L) was also significantly lower than that of the diabetic untreated group (1.90±0.89 mmol/L). The entire results on the effect of various treatments on triglyceride concentrations of diabetic rats are presented in Table 1.

High-density lipoprotein concentration was significantly decreased in the diabetic untreated rats (group 9) when compared with the normal control animals (P<0.05). This is known as the good lipoprotein because it carries cholesterol to the liver and the liver then removes it from the body. HDL value in the normal control group was 1.62±0.80 mmol/L while in the diabetic untreated group, was 1.51±0.42 mmol/L. This indicated that diabetes promoted the formation of more cholesterol than phospholipids. This caused a decrease in the diabetic untreated animals. The presence of diabetic caused a decrease in the high density lipoprotein of the diabetic treated groups (GRP1 –GRP7) when compared with the control animals (GRP8). However, the untreated animal had significant decrease (Table 1).

Yam species and the Moringa seed meal significantly decreased LDL concentrations in all diabetic treated rats' animals when compared with the diabetic untreated rats (group 9).

4. DISCUSSION

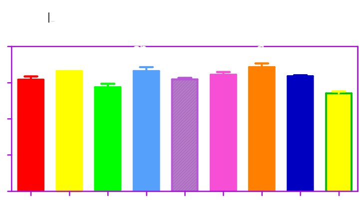
In this study, the effects of the administrations of different yam varieties and moringa seed meal on the biochemical parameters of alloxan-induced rats was evaluated in rats with results showing significant improvement in liver functions, lipid profile and renal functions of the diabetic treated rats when compared with the untreated diabetic ones in group 9 (P<0.05).

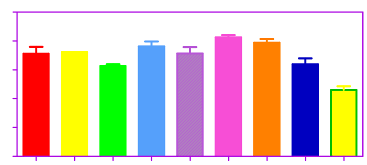
Intraperitoneal administration of Alloxan monohydrate (160 mg/kg) to the experimental rats successfully made the animals diabetic by the end of 48hr of the administration and was evidenced by a marked increase in the blood glucose levels of the test rats (i.e hyperglycemia). It is indeed established that the onset of diabetes mellitus is usually accompanied by hyperglycaemia [12,13]. The induction of diabetes mellitus by alloxan monohydrate is made possible due to the selective destructive effects of the agent on the beta cells of the pancreatic islets of Langerhans. These beta cells are involved in the synthesis, storage and release of insulin, the peptide hormone which regulates carbohydrate, protein and lipid metabolism, keeping their concentrations within tolerable limits [12,14]. When destroyed by alloxan, the beta cells become unable to synthesize and secrete the adequate amount of insulin necessary for the metabolism of carbohydrate resulting in the onset of diabetic mellitus.

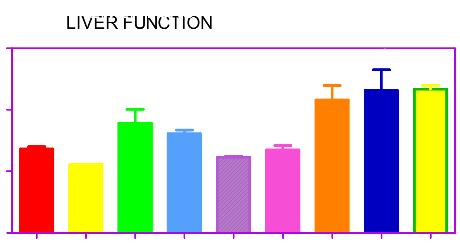
Table 1. Lipid profile of alloxan induced diabetic albino rats

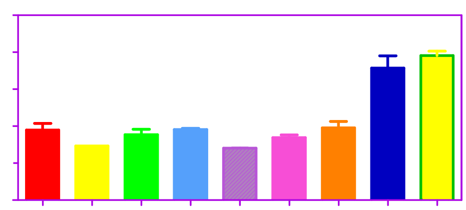
Samples	Treatments	CHOL(g/L)	TRIGYL (mmol/L)	HDL (mmol/L)	LDL (mmol/L)	VLDL (mmol/L)
GRP1	Diabetic(DAC)	1.71^{c}±0.27	0.75^{bc}±0.25	1.66^{ef}±0.33	0.27^{ab}±0.12	0.37^{b}±0.12
GRP2	Diabetic (DA90M10)	1.83^{c}±0.00	0.63^{c}±0.00	1.99^{de}±0.00	0.90^{a}±0.00	0.80^{a}±0.00
GRP3	Diabetic DCC)	1.92^{c}±0.69	1.75^{a}±1.07	1.79^{de}±0.19	0.43^{ab}±0.23	0.47^{b}±0.20
GRP4	Diabeticdc90m10	2.56^{b}±0.21	1.24^{b}±0.54	2.51^{ab}±0.28	0.50^{ab}±0.20	0.57^{ab}±0.25
GRP5	Diabetic(DRC)	1.99^{c}±1.55	0.65^{c}±0.25	2.11^{cd}±0.25	0.35^{ab}±0.50	0.30^{b}±0.00
GRP6	Diabetic (DR90M10)	2.68^{ab}±1.40	0.65^{c}±0.04	2.65^{a}±0.55	0.25^{ab}±0.05	0.30^{b}±0.00
GRP7	Diabetic (MRGA)	2.42^{b}±0.27	0.88^{bc}±0.17	2.24^{bc}±0.24	0.20^{ab}±1.00	0.37^{b}±0.58
GRP8	Non diabetic	1.83^{c}±0.10	1.02^{bc}±0.53	1.63^{f}±0.80	0.30^{ab}±0.20	0.45^{b}±0.25
GRP9	Diabetic Untreated	2.91^{a}±0.15	1.90^{a}±0.89	1..51^{g}±0.42	1.06^{a}±0.29	0.37^{b}±0.28

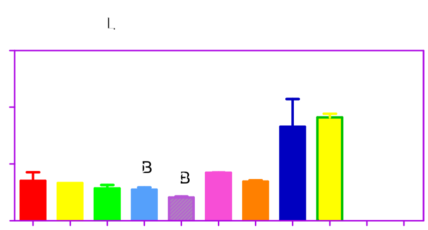
Values are expressed as mean ±SD in triplicate determination, values with superscript across the column is significantly different at (P<0.05)

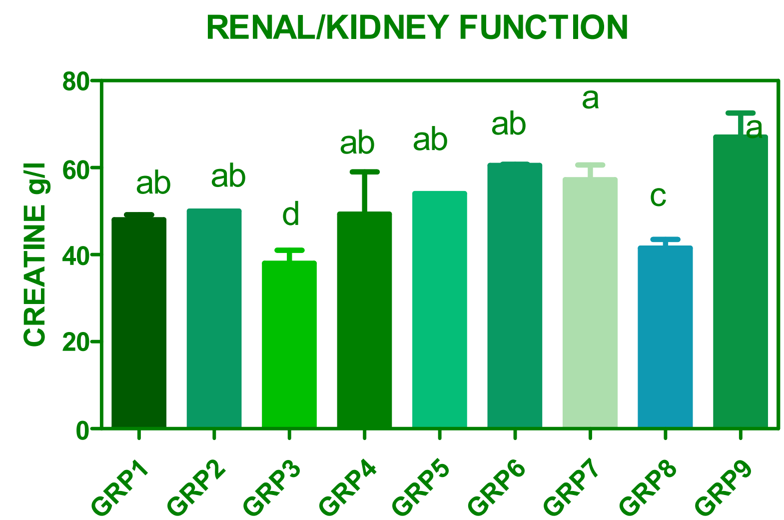












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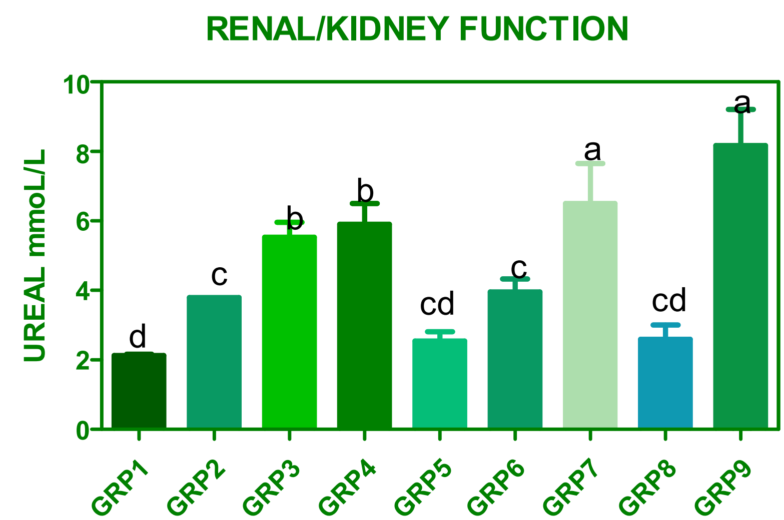

fig7

The fact that the various yam species administered to the diabetic rats were able to provide significant positive changes in the rats suggests that the administered agents may contain substances with significant hypoglycemic effects and may have achieved the observed anti-hyperglycemic effect by increasing insulin secretion or increased peripheral utilization of glucose in the diabetic rats [14], inhibition of endogenous glucose production [15], inhibition of intestinal glucose absorption [16], potentiating pancreatic secretion of insulin from existing residual beta cells or by the combination of two or more of these mechanisms. The presence of phytochemical agents such as flavonoids, phenolics and tannins in these yam varieties and moringa seed may have been responsible for their observed hypoglycemic effect. Flavonoids, phenolic compounds and tannins have all been implicated in antioxidative effects, wound healing, cellular regeneration and cytoprotection [17]. The presence of these phytochemical agents in the yam varieties and moringa may have facilitated the regeneration of the damaged beta cells and offered protection to the residual ones via the antioxidant pathway. The overall effect of the biochemical interplay arising from may have resulted into improved beta cells activities and insulin secretion.

The diabetic untreated rats had significantly higher total cholesterol, triglycerides, LDL-C and VLDL-C values with fall in HDL-C values when compared with the normal control which received no induction agent. Elevated total cholesterol, triglycerides, LDL-C and VLDL-C with fall in HDL are established biochemical markers which accompany the onset of diabetes mellitus and have been reported to be due to increased mobilization of free fatty acids from the peripheral fat depots into blood vessels and predisposes patients to cardiovascular problems [13,14,18]. This may be due to low insulin level as seen in diabetic uncontrolled animals furthermore, Kusunoki et al. [19] reported that (streptozotocin) STZ-induced diabetic rats had low plasma insulin levels and since insulin is low there is the tendency of having low Lipoprotein lipase; this brings about high plasma levels of TG, FFA and low levels of HDL.

Results of treatment with the various yam varieties and moringa seed meal showed significant fall in total cholesterol, triglycerides, LDL-C and VLDL-C and increased HDL-C in the diabetic treated animals and suggest that both the yam varieties and moringa seed may contain potent anti-hyperglycemic substances and as such may be of value in the prevention/management of hyperlipidaemia and cardiovascular traumas of diabetes mellitus. Saponins have been greatly associated with the prevention and management of cardiovascular problems via the anti-hyperlipidemic pathway [17], and results of this study have shown that the yam varieties and moringa seed meal used have significant amounts of saponins and therefore may be responsible for the observed lipid- lowering effect of the treatment agents. Results of similar studies involving treatment with *Moringa oleifera* leaves and seeds also showed highly significant anti-hyperlipidaemic effects [20] and agree strongly with that of this study.

The diabetic untreated rats had significantly lower total protein and albumin concentrations with elevated serum AST and ALT concentrations with when compared with the un-induced ones and suggest that the liver may have been threatened by both the oxidative effect of the induction agent and the physiological changes associated with the onset of diabetes mellitus. Total protein is a clinical value which is used in understanding disease condition [21].

In general, liver function tests give information about the state of the liver, describing its functionality (albumin and lipid profile), cellular integrity (transaminases) and its link with biliary tract (ALP) [22]. The Rise in AST, ALT and ALP values beyond acceptable limits indicate an early diagnosis of hepatotoxicity and tissue damage. The increase in serum concentrations of these liver enzymes is usually due to damage to the hepatocytes and cell necrosis of many tissues [23]. For example, pathology involving the skeletal or cardiac muscle and/or the hepatic parenchyma allows for the leakage of large amounts of AST into the blood [24]. Treatment as administered in this study significantly lowered the levels of these enzymes in all treated diabetic rats and further attests to the possible use of the treatment agents to manage diabetes and its associated problems. Findings in this study had revealed the presence of phytochemical substances of medicinal value in the treatment agents, some of which are reported to possess hepatoprotective activity. Worthy of mention here are the flavonoids [25,26].

Serum creatinine and urea concentrations were also significantly higher in the untreated diabetic rats when compared with both the un-induced and the diabetic but treated rats. Urea is formed in the liver and is mainly excreted by the kidneys. Consequently, urea is useful in evaluating kidney function in conjunction with creatinine which originates from the muscle and is filtered by the kidney. The majority of the blood urea is synthesized in the liver from ammonia. Once formed, urea diffuses freely throughout all body fluids. The kidney is the most important route of urea excretion and as a result, urea has long been used as a barometer of renal function [27]. The elevation in urea and creatinine concentrations in the diabetic rats may still be related to the impact of diabetes mellitus on the renal system. High urea and creatinine levels represent important kidney dysfunction markers. The removal of this kidney dysfunction parameter in the form of the urea and Creatinine level could be explained by the attenuation of oxidative stress situation through serum glucose level regulation [3]. In a similar study elevation of urea and creatinine levels in the serum had been taken as the index of nephrotoxicity [28]. Most creatinine originates from the non-enzymatic conversion of creatinine in muscular and elevated values may be associated with muscular dystrophy often seen among diabetics [29]. Results of similar studies have shown that both urea and creatinine concentrations usually increase with the onset and/or progression of diabetes mellitus [8].

The result showed a decrease in creatinine and Ureal values of diabetic treated animals when compared to the diabetic untreated animals. This indicated toxicity of the liver as a result of the disease condition, Lipid is deposited on the kidney of diabetic human and experimental animals, which is the cause of diabetic kidney disease. The decease can be due to elevated sterol regulatory element-binding protein (SREBP)-1 and fatty acid synthase, therefore, resulting in increased renal accumulation and glomerulosclerosis.

The decease can be due to elevated sterol regulatory element-binding protein (SREBP)-1 and fatty acid synthase therefore resulting in increased renal accumulation and glomerulosclerosis. Treatment of diabetic treated animals with yam and moringa blend caused a decrease in the renal compared with the diabetic untreated animal. The property in yam and moringa must have regenerated the beta cell and cause secretion of insulin. This can be supported by the work of Kolsi et al. [1] who reported that is a medicinal plant rich in phytochemical, He further stated that the oral treatment of diabetic rats with (CNSP) caused b-cells regeneration in the pancreas, which led to an increase insulin secretion. Further on this insulin is known to activates the enzyme lipoprotein lipase. The presence of insulin activates the function of lipoprotein lipase, produced in the adipocyte, this is responsible for the regulation of the inflow of triglyceride fatty acid and very-low-density lipoproteins from the bloodstream into the extrahepatic tissues. Lipoprotein lipase must have resulted in the reduction of the elevated SREBP and fatty acid which initially was the reason for an increase in the Creatinine and Urea. Treatment with the yam varieties and moringa seed meal also significantly improved renal functions in the diabetic rats.

Lowering, both urea and creatinine concentrations. Antioxidant effects of flavonoids and phenolic compounds present in the treatment agents may be implicated in this regard. These phytochemical agents have been reported to improve renal functions [7].

5. CONCLUSION

The result of this research work has shown that *Dioscorea alata, Discorea cayennessis* and *Diocorea rotundata* and *Moringa oleifera* seed meal has a preventive and corrective effect as evidence in the evaluation of biochemical parameter, namely; lipid profile, liver and kidney function level, in the alloxan diabetic male albino rats. Furthermore, the result indicated that yam moringa seed meal blend as reported in this work may be used for the production of therapeutic and pharmaceutical formulation in the control and treatment of diabetes and it associated complication. More study can be carried out on the extraction of the individual bioactive components in the yam species to evaluate their anti-diabetic property.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kolsi BAR, Gara BA, Jardak N, Chaaben R, El Feki A, El Feki L, et al. Inhibitory effects of *Cymodocea nodosa* sulphated polysaccharide on α-amylase activity, liver-kidney toxicities and lipid profile disorders in diabetic rats. Archives of Physiology and Biochemistry. 2015;121(5):218-27.

2. Takeda S, Sato N, Rakugi H, Morishita R. Molecular mechanisms linking diabetes mellitus and Alzheimer disease: Beta-amyloid peptide, insulin signaling, and neuronal function. Molecular Biosystems. 2011;7(6):1822-7.
3. Jdir H, Kolsi RBA, Zouari S, Hamden K, Zouari N, Fakhfakh N. The cruciferous *Diplotaxis simplex*: Phytochemistry analysis and its protective effect on liver and kidney toxicities, and lipid profile disorders in alloxan-induced diabetic rats. Lipids in Health and Disease. 2017;16(1): 100.
4. Saravanan G, Ponmurugan P. Ameliorative potential of S-allylcysteine: Effect on lipid profile and changes in tissue fatty acid composition in experimental diabetes. Experimental and Toxicologic Pathology. 2012;64(6):639-44.
5. Edoga C, Njoku O, Amadi E, Okeke J. Blood sugar lowering effect of *Moringa oleifera* lam in albino rats. Int J Sci Technol. 2013;3(1):88-90.
6. Tamiru W, Engidawork E, Asres K. Evaluation of the effects of 80% methanolic leaf extract of *Caylusea abyssinica* (fresen.) fisch. & Mey. on glucose handling in normal, glucose loaded and diabetic rodents. BMC Complementary and Alternative Medicine. 2012;12(1):151.
7. Efiong E, Igile G, Mgbeje B, Otu E, Ebong P. Hepatoprotective and anti-diabetic effect of combined extracts of *Moringa oleifera* and *Vernonia amygdalina* in streptozotocin-induced diabetic albino wistar rats. Journal of Diabetes and Endocrinology. 2013;4(4):45-50.
8. Fombang EN, Saa RW. Antihyperglycemic activity of *Moringa oleifera* Lam leaf functional tea in rat models and human subjects. Food and Nutrition Sciences. 2016;7(11):1021.
9. Addy RNA. Comparative study on the properties of yam (*Dioscorea rotundata*) varieties in Ghana: A case study in Asante Mampong; 2012.
10. Lee M-H, Lin Y-S, Lin Y-H, Hsu F-L, Hou W-C. The mucilage of yam (*Dioscorea batatas* Decne) tuber exhibited angiotensin converting enzyme inhibitory activities. Botanical Bulletin of Academia Sinica. 2003;44.
11. Selma S, Khalid H, Ahmed S. Anti-diabetic activity of the leaves of *Moringa oleifera* Lam. growing in sudan on streptozotocin-induced diabetic rats. Brit J Med Health Res. 2016;3(4):48-57.
12. ISN. Blood coagulation tests and platelets counts in diabetic rats treated with *Ficus sur*, *Jatropha tanjorensis*, *Mucuna pruriens* and *Chromolaena odorata* leaf extracts. International Blood Research & Reviews. 2015;3(1):47-53.
13. Akomas S, Okafor A, Ijioma S. Hypoglycemic, hematologic and hypo-lipidemic activity of *Mucuna pruriens* ethanol leaf extract in alloxan induced diabetic rats. Annual Research & Review in Biology. 2014;4(24):4284.
14. Adeyi AO, Idowu BA, Mafiana CF, Oluwalana SA, Ajayi OL, Akinloye OA. Rat model of food-induced non-obese-type 2 diabetes mellitus: Comparative pathophysiology and histopathology. International Journal of Physiology, Pathophysiology and Pharmacology. 2012;4(1):51.
15. Vasim K, Abulkalam N, Mohd A, Mohd M, Pillai KK. A pharmacological appraisal of medicinal plants with antidiabetic potential. Journal of Pharmaceutical and Bioallied Sciences. 2012;1:27-42.
16. Ghatak SB, Panchal SS. Anti-diabetic activity of oryzanol and its relationship with the anti-oxidant property. International Journal of Diabetes in Developing Countries. 2012;32(4):185-92.
17. Oshilonya HU, Oshilonya LU, Ijioma SN. Phytochemical analysis and preliminary *in vitro* non mutagenic activity of *Caulis bambusae* stem extract. International Journal of Healthcare Sciences. 2017;5(1): 349-53.
18. Michael UA, David BU, Theophine CO, Philip FU, Ogochukwu AM, Benson VA. Antidiabetic effect of combined aqueous leaf extract of *Vernonia amygdalina* and metformin in rats. Journal of Basic and Clinical Pharmacy. 2010;1(3):197.
19. Kusunoki MTK, Natsume Y, Tsutsui H, Miyata T, Oshida Y. Lipoprotein lipase and atherosclerosis. International Journal of Collaborative Research on Internal Medicine & Public Health. 2015;7(9).
20. Jaiswal D, Rai PK, Mehta S, Chatterji S, Shukla S, Rai DK, et al. Role of *Moringa oleifera* in regulation of diabetes-induced oxidative stress. Asian Pacific Journal of Tropical Medicine. 2013;6(6):426-32.
21. Sumesh P, Sah MA, Sudeep K, Jyoti B, Imran M, Lalendra Y. Effect of PEM on thyroid status, serum total protein and A/G

ratio inpre-school going children. International Journal of Research in Medical Sciences. 2017;5(10):4486-9. Available:www.msjonline.org

22. Ezejiofor A, Orish C, Orisakwe OE. Effect of aqueous leaves extract of Costus afer Ker Gawl (Zingiberaceae) on the liver and kidney of male albino wistar rat. Ancient Science of Life. 2013;33(1):4.
23. Amin KA, AlMuzafar HM. Alterations in lipid profile, oxidative stress and hepatic function in rat fed with saccharin and methyl-salicylates. International Journal of Clinical and Experimental Medicine. 2015;8(4):6133.
24. Cornelius C. Serum enzyme activities and other markers for detecting hepatic necrosis, cholestasis or cocarcinoma. Kaneko JJ, Harvey JW and Bruss LM (ed). 1989;381-6.
25. Lewis DA, Fields WN, Shaw GP. A natural flavonoid present in unripe plantain banana pulp (*Musa sapientum* L. var. paradisiaca) protects the gastric mucosa from aspirin-induced erosions. Journal of Ethnopharmacology. 1999;65(3):283-8.
26. Kumar M, Gautam MK, Singh A, Goel RK. Healing effects of Musa sapientum var. paradisiaca in diabetic rats with co-occurring gastric ulcer: Cytokines and growth factor by PCR amplification. BMC Complementary and Alternative Medicine. 2013;13(1):305.
27. Corbett JV. Laboratory tests and diagnostic procedures with nursing diagnoses. 2008;90–107.
28. Omobowale T, Oyagbemi A, Abiola J, Azeez I, Adedokun R, Nottidge H. Effect of chronic administration of methanol extract of *Moringa oleifera* on some biochemical indices in female wistar rats. Nigerian Journal of Physiological Sciences. 2014;29(2):107-11.
29. Gowda S, Desai PB, Kulkarni SS, Hull VV, Math AA, Vernekar SN. Markers of renal function tests. North American Journal of Medical Sciences. 2010;2(4):170.

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