

Evaluation Of The Effects Of Methanol Extracts Of Leaf And Stem Bark Of Buchholziacoriaceae (Wonderful Kola) On Some Biochemical Parameters Of Streptozotocin-Induced Diabetic Rats.

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Abstract: The hypoglycemic, hypolipidemic and hypocholesterolemia effects of the methanol extracts of leaf and stem bark of Buchholziacoriaceae were studied in normal and streptozotocin-induced diabetic male wistar rats. The result of the phytochemical screening of the extracts revealed that the leaf contains tannins, saponins, terpenes and terpenoids, cardiac glycosides, balsam, phenols and resins. On the other hand, the stem bark contains alkaloids, flavonoids, tannins, terpenes and terpenoids, cardiac glycosides, balsam, phenols and resins. The following biochemical parameters were determined in the serum using standard laboratory procedure, glucose, total protein, urea, creatinine, cholesterol, triglycerides, aspartate amino transferase (AST), alanine amino transferase (ALT) and alkaline phosphatase (ALP) were determined. Also, the serum electrolytes like sodium, potassium, calcium, chloride, and bicarbonate were determined. The leaf and stem bark extracts were prepared in two concentrations of 150 and 250mg/kg body weight. Each sample with its respective concentrations were administered to diabetic groups intraperitoneally for 14 days. The results of the treatment of the diabetic groups at the different concentrations of the extracts shows significant decrease ($p < 0.05$) in the elevated blood levels of glucose, urea, creatinine, cholesterol, triglyceride, haemoglobin, aspartate amino transferase and alanine transferase associated with streptozotocin-induced diabetic rats. On the other hand, there were significant increase ($p < 0.05$) in the levels of chloride, potassium and calcium levels when diabetic groups were treated at both concentrations of samples. From the study, the methanol leaf and stem bark extracts of Buchholziacoriaceae have proven to be effective as hypoglycemic, hypocholesterolaemic and hypotriglyceridaemic agent and therefore, may be used for the management of diabetes mellitus.

Keywords: Buchholziacoriaceae, streptozotocin, hypolipidaemic, hypoglycemic, hypocholesterolaemic.

Date of Submission: 22-02-2018

Date of acceptance: 08-03-2018

I. Introduction

Medicinal plants in traditional system of healing have been the source of inspiration for several major pharmaceutical drugs. Great advances of modern scientific medicine have been challenged by rapid increase in the use of complementary or alternative medicine worldwide. This is more pronounced in the developing countries where traditional medicine is still primarily used in treating most diseases even among those with access to modern medicine [1].

Diabetes has become a disease of major Public Health concern with adverse health and economic effects, and is responsible for increased risk for atherosclerosis, coronary heart disease, stroke, myocardial infarction, renal disease and periodontitis [2]. It is estimated about 347 million people worldwide are diabetic, with a prevalence of 8.3% [3]. According to World Health Organization, about 1.5 million deaths were directly caused by diabetes in 2012, most of these occurring in low and middle-income countries. North America and the Caribbean accounts for the highest prevalence of diabetes (11%), translating to about 36,755 diabetics,

following closely is the Middle East and North Africa with 34,571 people with diabetes. However, in Western Pacific region, diabetes has a prevalence of 8.6% [4]. The incidence of diabetes is gradually increasing and is projected to be the 7th cause of death worldwide by 2030 [3], with the greatest increase in prevalence expected to occur in Africa and Asia due to urbanization and lifestyle changes [5]. In many developing countries, diabetics use alternative medicines sometimes alone or in combination with orthodox medication. Although numerous studies have suggested that certain plants have anti diabetic effect, there are a few studies on indices to prove the hypoglycemic effect of many of these plants [6].

Buchholziacoriaceae (wonderful kola) is widely used by some local communities in Nigeria as a medicinal plant. Herbal practitioners reported its antidiabetic properties and ability to reduce blood sugar level. However, little or no similar studies have been carried out on the leaf and stem bark of the plant. It is a perennial plant which grows as a tree. It belongs to the family *caparaceae* and genus *Buchholzia* [7]. The seeds gave the plant its common name because of its popular usage in traditional medicine [8], such as in the cure for many diseases including diabetes. The seeds are covered in purple aril which are chewed in Ivory Coast and has a pungent taste. It is used to treat a variety of illnesses. The tree is found in the southern part of Nigeria, Ghana and Liberia. The bark can be made into a pulp for inhalation or into a snuff to relieve headache, sinusitis, and nasal congestion in Ivory Coast; smallpox or skin itching in Gabon [1].

II. Materials and Methods

2.1 Materials

2.1.1 Plant Material

Buchholziacoriaceae “wonderful kola” plant was collected in the month of May from Nsukka North Local Government Area of Enugu State. The plant was identified and authenticated at the Federal School of Forestry, Jos, Plateau State.

2.1.2 Study Animals

White albino rats (Wistar Strain) weighing between 80-150kg used in this study were purchased from the animal house of the University of Jos. All the rats used were young adult males. Before and during the experiment, the rats were allowed free access to standard pellet feed (purchased from Grand Cereal and Oil Mills Ltd Jos) and water. They were left to acclimatize for one week.

2.2 Methods

2.2.1 Induction of diabetes:

Diabetes was induced in male wistar albino rats (80–150kg body weight) by intraperitoneal administration of STZ (single dose of 55 mg/kg bw) dissolved in freshly prepared 0.01 M citrate buffer, pH 4.5. After 48h rats with marked hyperglycemia (fasting blood glucose >140 mg/dl) were selected and used for the study. All the animals were allowed free access to water and diet and maintained at room temperature in plastic cages [9].

2.2.2 Preparation of Plant Extracts

The plant leaf and stem bark were collected, air dried at room temperature under the shade for three weeks. The plant parts were then pounded to powdery form using local pestle and mortar. The powdery form was sieved to obtain fine powder. The fine powdery form of the plant was stored in air-tight plastic containers until required for use. The preparation of the decoctions (plant extracts) was by methanol, 100g each of the fine powdered leaf and stem bark were dissolved in one (1) litre of methanol for 24 hours. It was then filtered using white cloth and whatman filter paper No. 1 to remove all un-extractable matter, the filtrates were concentrated in water bath at a temperature of 60°C and stored in air-tight containers and stored in a desiccator. Secondly, the dried samples were later reconstituted with distilled water to give the required dosage of 150mg/kg and 250mg/kg body weight.

2.2.3 Treatment of Experimental Animals

After randomization into various groups and before initiation of experiment, the rats were acclimatized to the animal house conditions (Kumalet al., 2006). Male rats weighing 80-150kg were divided into seven groups of 5 rats each.

GROUP 1: Normal Control rats (NC)

GROUP 2: Diabetic control rats (DC) STZ at 55mg/kg

GROUP 3: Diabetic Treated rats with Leaf Extract at 150mg/kg/day) (DTL1)

GROUP 4: Diabetic Treated rats with Leaf Extract at 250mg/kg/day) (DTL2)

GROUP 5: Diabetic Treated rats with Stem Bark Extract at 150mg/kg/day) (DTSB1)

GROUP 6: Diabetic Treated rats with Stem Bark Extract at 250mg/kg/day) (DTSB2)

GROUP 7: Diabetic Treated rats with Standard drug (glibenclimide) at 2.5mg/kg/day (DTS)

The rats were maintained on normal feed and groups 3-6 were administered with extracts for 28 days through intragastric tube.

2.2.4 Blood Sample Collection

The administrations were done for 28 days. On day 28, bloods are collected by cardiac puncture under mild ether anesthesia from overnight fasted rats and fasting blood sugar are estimated.

The blood was collected in clean dry centrifuge tubes and was allowed to clot for 40 minutes and spun at 5,000 rpm for 10 minutes. The serum was collected and transferred to bijoux bottles and kept for analysis.

2.2.5 Statistical Analysis

The result values are expressed as mean \pm SEM. Data were analyzed using one-way analysis of variance (ANOVA) at 95% level of significance.

III. Results

Table 1: Results of Effects of Leaf and Stem Bark Extracts of *B. coriacea* on Levels of Some Biochemical Parameters of Streptozotocin-Induced Diabetic Rats.

	Glu (mMol/L)	T/Protein (g/l)	Albumin (g/l)	D/Bilirubin (μ M/l)	T/Bilirubin (μ M/l)
NC	4.00 \pm 0.26	78.14 \pm 0.74	38.75 \pm 0.823	57 \pm 0.37	7.85 \pm 0.25
DC	19.03 \pm 0.39 ^a	59.32 \pm 1.35 ^a	29.08 \pm 0.66 ^a	10.63 \pm 0.30 ^a	29.68 \pm 0.66 ^a
DTL1	7.45 \pm 0.70 ^{ab}	61.86 \pm 1.25 ^{ab}	34.57 \pm 0.74 ^{ab}	11.06 \pm 1.64 ^a	25.56 \pm 1.26 ^{ab}
DTL2	10.84 \pm 0.44 ^{abc}	66.06 \pm 1.20 ^{abc}	37.09 \pm 0.84 ^{abc}	9.96 \pm 0.77 ^a	23.79 \pm 0.57 ^{abc}
DTSB1	10.99 \pm 0.91 ^{ab}	53.35 \pm 0.57 ^{ab}	36.52 \pm 0.68 ^{ab}	6.62 \pm 0.89 ^{ab}	14.71 \pm 0.77 ^{ab}
DTSB2	14.18 \pm 1.71 ^{abc}	59.86 \pm 0.48 ^{ac}	33.70 \pm 0.41 ^{abc}	5.62 \pm 0.77 ^{ab}	13.46 \pm 0.91 ^{ab}
DTS	9.59 \pm 0.30 ^{ab}	74.70 \pm 0.70 ^{ab}	37.94 \pm 0.56	5.62 \pm 0.77 ^{ab}	15.15 \pm 0.60 ^{ab}

NC=Normal Control, DC= Diabetic Control, DTL1= Diabetic Treated group with Leaf Extract at 150mg/bw, DTL2= Diabetic Treated group with Leaf Extract at 250mg/bw, DTSB1= Diabetic Treated group with Stem Bark Extract at 150mg/bw, DTSB2= Diabetic Treated group with Stem Bark extract at 250mg/bw, DTS= Diabetic Treated group with Standard Drug (glibenclimide)

Data are mean \pm SEM, n=5

^avalues are significant when compared with normal control (p<0.05).

^bvalues are significant when compared with diabetic control (p<0.05)

^cvalue are significant when compared with different doses of the same sample (p<0.05).

Table 2: Result of Effects of Leaf and Stem Bark Extracts of *B. coriacea* on Urea, Uric Acid, and Creatinine on Streptozotocin-Induced Diabetic Rats.

	Urea (mMol/l)	Uric Acid (μ M/l)	Creatinine (μ M/l)
NC	5.37 \pm 0.39	201.53 \pm 4.66	83.12 \pm 4.66
DC	19.55 \pm 0.66 ^a	591.02 \pm 19.19	374.11 \pm 43.67 ^a
DTL1	16.29 \pm 0.79 ^{ab}	484.37 \pm 16.25	322.47 \pm 27.78 ^{ab}
DTL2	15.39 \pm 0.64 ^{ab}	461.18 \pm 12.91	295.64 \pm 6.87 ^{ab}
DTSB1	13.94 \pm 0.91 ^{ab}	310.40 \pm 0.34	254.65 \pm 19.84 ^{ab}
DTSB2	12.64 \pm 0.79 ^{ab}	290.74 \pm 9.19	240.58 \pm 13.66 ^{ab}
DTS	14.39 \pm 1.15 ^{ab}	433.74 \pm 51.22	226.99 \pm 13.66 ^{ab}

NC=Normal Control. DC= Diabetic Control, **DTL1**= Diabetic Treated group with Leaf Extract at 150mg/bw, **DTL2**= Diabetic Treated group with Leaf Extract at 250mg/bw, **DTSB1**= Diabetic Treated group with Stem Bark Extract at 150mg/bw, **DTSB2**= Diabetic Treated group with Stem Bark extract at 250mg/bw, **DTS**= Diabetic Treated group with Standard Drug (glibenclimide)

Data are mean ± SEM, n = 5

^avalues are significant when compared with normal control (p<0.05).

^bvalues are significant when compared with diabetic control (p<0.05)

^cvalue are significant when compared with different doses of the same sample (p<0.05).

Table 3: Result of Effects of Leaf and Stem Bark Extracts of *B. coriacea* on Level of Some Serum Electrolytes of Streptozotocin- Induced Diabetic Rats

GP	Na ⁺ (mM/l)	Cl ⁻ (mM/l)	K ⁺ (mM/l)	Ca ²⁺ (mM/l)	HCO ₃ ²⁻ (mM/l)	PO ₃ ²⁻ (mMol/l)
NC	146.20±1.30	113.40±0.55	3.72±0.02	2.40±0.11	24.600±0.55	1.17±0.050
DC	134.00±0.71 ^a	102.40±0.55 ^a	5.81±0.06 ^a	1.578±0.09 ^a	17.400±0.55 ^a	1.89±0.08 ^a
DTL1	137.80±0.84 ^{ab}	110.20±0.84 ^{ab}	5.18±0.03 ^{ab}	2.098±0.07 ^{ab}	21.600±0.55 ^{ab}	1.398±0.01 ^b
DTL2	138.40±0.89 ^{ab}	110.40±0.53 ^{ab}	5.05±0.04 ^{ab}	2.010±0.06 ^{ab}	22.600±0.55 ^{ab}	1.406±0.08 ^b
DTSB1	132.60±0.55 ^a	104.80±0.84 ^{ab}	4.66±0.71 ^{ab}	1.560±0.05 ^a	16.600±0.55 ^a	1.616±0.25 ^a
DTSB2	132.00±2.12 ^a	103.40±1.95 ^a	4.27±0.36 ^{ab}	1.548±0.26 ^a	17.400±0.55 ^a	1.442±0.12 ^a
DTS	138.40±1.14 ^{ab}	108.40±0.89 ^{ab}	4.73±0.06 ^{ab}	1.982±0.07 ^{ab}	21.800 ± 0.84 ^{ab}	1.34 ± 1.12 ^b

NC=Normal Control. DC= Diabetic Control, **DTL1**= Diabetic Treated group with Leaf Extract at 150mg/bw, **DTL2**= Diabetic Treated group with Leaf Extract at 250mg/bw, **DTSB1**= Diabetic Treated group with Stem Bark Extract at 150mg/bw, **DTSB2**= Diabetic Treated group with Stem Bark extract at 250mg/bw, **DTS**= Diabetic Treated group with Standard Drug (glibenclimide)

Data are mean ± SEM, n = 5

^avalues are significant when compared with normal control (p<0.05).

^bvalues are significant when compared with diabetic control (p<0.05)

^cvalue are significant when compared with different doses of the same sample (p<0.05).

Table 4 Results of Effects of Leaf and Stem Bark Extracts of *B. coriacea* on Levels of Serum Lipid Profile of Streptozotocin-Induced Diabetic Rats.

T.CHOL. (mMol/l)	TRIG. (mMol/l)	HDL. (mMol/l)	LDL. (mMol/l)	
NC	3.81±0.16	0.92±0.05	1.26±0.11	1.79±0.08
DC	6.01±0.25 ^a	2.64±0.28 ^a	0.30±0.14 ^a	3.78±0.54 ^a
DTL1	4.25±0.26 ^b	1.67±0.24 ^{ab}	0.70±0.07 ^{ab}	2.98±0.46 ^{ab}
DTL2	4.63±0.23 ^{ab}	1.77±0.07 ^{ab}	0.91±0.08 ^{ab}	2.67±0.11 ^{ab}
DTSB1	4.33±0.53 ^b	1.46±0.09 ^{ab}	0.95±0.04 ^{ab}	2.47±0.12 ^{ab}
DTSB2	3.92±0.38 ^b	1.46±0.07 ^{ab}	0.98±0.08 ^{ab}	2.43±0.12 ^{ab}
DTS	4.71±0.60 ^{ab}	1.46±0.07 ^{ab}	0.91±0.18 ^{ab}	2.51±0.33 ^{ab}

NC=Normal Control. DC= Diabetic Control, **DTL1**= Diabetic Treated group with Leaf Extract at 150mg/bw, **DTL2**= Diabetic Treated group with Leaf Extract at 250mg/bw, **DTSB1**= Diabetic Treated group with Stem Bark Extract at 150mg/bw, **DTSB2**= Diabetic Treated group with Stem Bark extract at 250mg/bw, **DTS**= Diabetic Treated group with Standard Drug (glibenclimide)

Data are mean ± SEM, n = 5

^avalues are significant when compared with normal control (p<0.05).

^bvalues are significant when compared with diabetic control (p<0.05).

IV. Discussion

The management of diabetes with the agent devoid of any side effect is still a challenge in the medical practice. This concern has led to an increase demand for natural products with anti-hyperglycemic activity, having fewer side effects. Due to its high prevalence and potential deleterious effect on a patients physical and psychological state, diabetes mellitus which can result in morbid condition, is a major medical concern [10].

Streptozotocin (STZ) induces diabetes through β -cell toxicity by inhibition of O-GlcNAc-selective N-acetyl-b-d-glucosaminidase (OglcNAcase), the enzyme that removes O-GlcNAc from protein [11]. It has been reported that partial destruction of beta cells causes a reduction in insulin secretion which is materialized by a chronic hyperglycemia [12]. Intraperitoneal administration of STZ effectively induces diabetes in normal rats as reflected by glycosuria, hyperglycemia and body weight loss when compared with normal rats [13]. Glibenclamide, a sulphonylurea is a popular anti diabetic drug used widely to manage Type II diabetes and works by inhibiting adenosine triphosphate (ATP)-sensitive potassium channel in pancreatic β -cells. This inhibition causes cell membrane depolarization and opening of voltage dependent calcium channel, thus triggering an increase in intracellular cellular calcium into the beta cell which stimulates insulin release[11].

The serum glucose, total protein, urea, uric acid, creatinine, direct bilirubin, albumin and total bilirubin levels were measured in normal control, diabetic control, and diabetic administered groups of rats. There was significant increase ($P<0.05$) in blood glucose, total protein, urea, creatinine, direct bilirubin, albumin and total bilirubin in streptozotocin-induced diabetic rats. Administration of the different concentrations of both extracts increases the metabolism of glucose, the diabetic groups which were separately administered with leaf and stem bark extracts at 150mg/kg and 250mg/kg body weight showed a significant decrease ($p<0.05$) in blood glucose, urea, uric acid, creatinine, direct bilirubin and total bilirubin levels also, there was significant increase in albumin and total protein for both extracts and concentrations. The glucose levels are performed to determine if an individual's blood glucose is in normal range. This helps to detect hyperglycemia or hypoglycemia and diabetes. The cells of the body need glucose to obtain energy, it is also vital to the cells of the brain and the central nervous system [14].

The study above shows a significant increase ($p<0.05$) in the level of glucose in diabetic control group when compared to the normal control. The administration of both concentrations of leaf and stem bark extracts exhibits significant decrease in serum glucose level towards that of normal control group. These decrease in serum glucose is highly dose dependent as the glucose level increases significantly ($p<0.05$). The administration of standard drug to the diabetic group significantly decreases ($p<0.05$) the blood glucose levels in diabetic group when compared to the diabetic control group. Total protein is a measure of total protein in the blood, a low or high protein does not indicate a specific disease, but it does indicate that some additional test may be required to determine if there is a problem.

In the study above, there was significant decrease ($p<0.05$) in the levels of total protein in diabetic control group when compared to the normal control group. The administration of both concentrations of the extracts significantly increases ($p<0.05$) the level of total protein towards that of normal control. There was also a significant increase ($p<0.05$) in the level of total protein between the two concentrations of both leaf and stem bark extracts. Administration of diabetic group with drug does not exhibit any marked difference ($p>0.05$) in total protein when compared to diabetic administered groups of both extracts.

Albumin is approximately two third of the total protein circulating in the blood is albumin. This important protein keeps water inside the blood vessels, when the blood albumin level is too low, water can leak out of the blood vessels into other parts of the body and cause swelling. A low level of albumin in the blood can be caused by malnutrition, liver disease, kidney disease, severe injury or major bone fracture, and slow bleeding over a long period of time [15].

In this study, it was noted that the serum albumin concentration was significantly lowered ($P<0.05$) in the diabetic treated groups of leaf and stem bark extracts when compared to the normal control group, it was also observed to be significantly higher ($P<0.05$) than the diabetic control group. There was significant increase in the levels of albumin when diabetic treated groups were administered different concentrations of the leaf and stem bark extracts.

Urea is a waste product formed from the breakdown of proteins. Urea is usually passed out in the urine. A high blood level of urea indicates that the kidneys may not be working properly or that the patient has low body water content dehydrated [16]. The study above shows a significant increase ($p<0.05$) in serum urea of diabetic control group when compared to the normal control group. The administration of both concentrations of leaf and stem bark extracts to the diabetic groups significantly decreases ($p<0.05$) the level of serum urea towards that of normal control group. There was significant decrease ($p<0.05$) in the urea level when standard drug was administered to the diabetic group.

Uric acid is a chemical created when the body breaks down purines. Purines are found in some foods and drinks. These include liver, anchovies, mackerel, dried beans and peas, and beer. Most uric acid dissolves in blood and travels to the kidneys. From there, it passes out in urine. If the body produces too much uric acid or

does not remove enough if it, it can lead to a disorder. A high level of uric acid in the blood is called hyperuricemia[16].Hyperuricemia is an excess of uric acid in the blood. Uric acid passes through the liver, and enters the blood stream. Most of it is excreted through urine, or passes through the intestines to regulate "normal" levels.It is also possible to have too little uric acid in the blood, which is a symptom of liver or kidney disease. It's also a symptom of Fanconi syndrome, a disorder of the kidney tubules that prevents the absorption of substances such as glucose and uric acid[17].

The study above shows significant increase ($p<0.05$) in the levels of uric acid in diabetic control group when compared to the normal control group. The administration of both leaf and stem bark extracts to the diabetic groups significantly decreases ($p<0.05$) the levels of uric acid towards that of normal control group. The decrease in serum uric acid is highly dose dependent and the stem barks extract exhibits more efficacy in respect to the normal control group.Serum creatinine is primarily a metabolite of creatinine, almost all of which is located in skeletal muscle. The normal level of creatinine in humans is 0.8 to 1.4 mg/dL. Females usually have a lower creatinine (0.6 to 1.2 mg/dL) than males, because they usually have less muscle mass [17].

The result of this experiment reveals a significant increase ($p<0.05$) in the creatinine levels diabetic control group when compared to the normal control group. The administration of samples on diabetic groups at both concentrations significantly decreases ($p<0.05$) the level of creatinine towards that of normal control group after 14 days of treatment as compared to the diabetic control group, the stem bark extract exhibits more efficacy than the leaf extract. The dosage of both extract does not exhibit any significant difference.

Direct bilirubin is a specific form of bilirubin formed in the liver and excreted in the bile. Normally, very little of this form of bilirubin is present in the blood therefore; a slight high level of direct bilirubin is an indication of liver problem[18].Total bilirubin is a pigment in the blood that makes the blood plasma or serum yellow, when the bilirubin level in the blood is very high, it leads to jaundice. Bilirubin comes from the breakdown of old red blood cells in the blood. A high bilirubin level in the blood can be caused by too many red cells being destroyed by liver disease, or by blockage of the bile ducts. Fasting can also cause a slight increase in total bilirubin[18].

The result of this study shows a significant decrease ($p<0.05$) in the level of total bilirubin towards that of normal control when the diabetic treated groups were administered standard drug, both leaf and stem bark extracts at the different concentrations. There was also a significance decrease ($p<0.05$) in total bilirubin level with increase in the concentration of the leaf extract. It has been reported that the level of serum bilirubin is related to several diseases. There have been a number of studies reporting a negative relation between serum bilirubin and cardiovascular diseases (CVD) since Bernard *et al.*, [18] reported a negative relationship between serum bilirubin level and coronary artery disease.

Total cholesterol which is a fatty substance made in the body and absorbed from certain foods that are essential to the body. It plays an important role in cell membrane and in the biosynthesis of hormones; it also helps in the formation of bile acids. Total cholesterol is a measure of both types of cholesterol, the Low Density Lipoproteins (LDL) and the High Density Lipoproteins (HDL). When cholesterol levels are too high, cholesterol can be harmful by contributing to narrowed or blocked arteries [19]. Unfortunately, people with diabetes are more prone to having unhealthy high cholesterol levels, which contributes to cardiovascular disease[19]. By taking steps to manage cholesterol, individuals can reduce their chance of cardiovascular disease and premature death [19].

The study above showed a significant elevated level of total cholesterol in the diabetic control group when compared to the normal control group, this level significantly decreases towards normal, them diabetic groups were treated with both leaf and stem bark extracts at both concentrations. There was also a marked decrease in total cholesterol when diabetic group was administered standard drug.

Low-density-lipoprotein (LDL): Also known as bad cholesterol can deposit excess cholesterol in the arterial walls, restricting blood flow and causing a condition known as atherosclerosis[19]. Blocked arteries can lead to heart attack, stroke, or other complications. A high LDL-C level is associated with a higher risk for cardiovascular disease[19].

The study above shows a significant decrease ($P<0.05$) in LDL level towards normal when the diabetic treated groups were administered both leaf and stem bark extracts at the different concentrations as compared to the diabetic control group. A marked decrease was also observed between the diabetic control group and the diabetic treated standard group.High-density-lipoprotein (HDL): Also known as good cholesterol because they help to move cholesterol out of the body tissues to the liver where it is processed for excretion[19]. Lower than normal HDL levels are associated with an increased risk of heart disease[19]. The study above showed a significant increase towards normal; in the levels of HDL in diabetic treated groups of both leaf and stem bark extracts at both concentrations as well as the standard control group when compared to the diabetic control group.

Experimental evidence suggests that levels of HDL cholesterol may contribute to the pathophysiology of Type II diabetes through direct effects on plasma glucose levels [20]. Indeed, HDL cholesterol stimulates

pancreatic β -cell insulin secretion and modulates glucose uptake in skeletal muscle in different experimental and human settings [20].

Triglyceride is the most common type of fat in the body. Normal triglyceride levels vary by age and sex. A high triglyceride level combined with low HDL cholesterol or high LDL cholesterol is associated with atherosclerosis, the buildup of fatty deposits in artery walls that increases the risk for heart attack, peripheral artery disease and stroke[20].Diabetes tends to lower "good" cholesterol levels and raise triglyceride and "bad" cholesterol levels, which increases the risk for heart disease and stroke. This common condition is called diabetic dyslipidemia.Diabetic dyslipidemia means that lipid profile is going in the wrong direction. It's a deadly combination that puts patients at risk for premature coronary heart disease and atherosclerosis[20].

The result above shows a significantly elevated ($P<0.05$) level of triglyceride when diabetes was induced, this elevated level decreases significantly ($P<0.05$) towards that of normal control when standard drug, leaf and stem bark extracts were administered to the diabetic groups. Studies shows a link between insulin resistance, which is a precursor to type 2 diabetes, and diabetic dyslipidemia, atherosclerosis and blood vessel disease. These conditions can develop even before diabetes is diagnosed.

Liver Function Tests (LFTs) are commonly used in clinical practice to screen for liver disease, monitor the progression of known disease, and monitor the effects of potentially hepatotoxic drugs (Gowda *et al.*, 2009). The most common LFTs include the serum alanine aminotransferases (ALT), aspartate amino transferase (AST) alkaline phosphatase (ALP), bilirubin, albumin, and prothrombin time. Aminotransferases, such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST), measure the concentration of intracellular hepatic enzymes that have leaked into the circulation and serve as a marker of hepatocyte injury. Alkaline phosphatase (AP) -glutamyltranspeptidase (GGT), and bilirubin act as markers of biliary function and cholestasis. Albumin and prothrombin reflect liver synthetic function[21].

Alkaline phosphatase (ALP) is a protein that helps to bring about chemical reactions in the body, it is found mainly in the liver and bones. High levels of ALP in the blood may indicate liver or bone abnormalities. High ALP values are accompanied by high values of other liver enzymes and bilirubin; this test suggests liver involvement. The study above shows a significant decrease towards normal; in levels of ALP in diabetic treated groups with extracts of both leaf and stem bark at both concentrations when compared to diabetic control group[21].Aspartate amino transferase (ALT)is also found mainly in liver, smaller quantities can also be found in kidney, heart and muscles. Levels of the enzymes are usually assessed in conjunction with readings for other liver enzymes to determine or monitor liver involvement. Very high levels of ALT may suggest acute hepatitis[21].

The study above showed a significant decrease ($p<0.05$) towards normal; in the levels of ALT in diabetic treated groups with both leaf and stem bark extracts when compared to the diabetic control group. Several reports have indicated that among these enzymes, elevated baseline levels of GGT and ALT are each associated with increased risk of future Type II diabetes mellitus. Aspartate aminotransferase (AST) is an enzyme found mainly in the liver, heart and muscles. It is released into the blood by injured liver or muscle cells but is used primarily to detect liver damage. Levels of AST are usually viewed alongside other liver enzymes to assess for liver damage. Like ALT, very high AST may suggest acute hepatitis[22].

V. Conclusion

In conclusion, the ability of *B. coriacea* to reduce blood glucose level in the animals may partly explain its usage by traditional medical practitioners in the treatment and management of diabetes. The two extracts also decrease serum cholesterol level and elevated the level of protein in the blood. The hypoglycemic activity of *B. coriacea* was found to be more on the leaf extract than the stem bark extract. This result provides scientific basis for the local usage of *B. coriacea* in the management of diabetes mellitus as there was significant reduction in the blood glucose and lipid levels over time.

VI. Recommendation

Further investigation is necessary to determine the exact phytoconstituent(s) responsible for antidiabetic effect. Also, to elucidate the exact mechanism of action.

References

- [1] C. D. Luka, and A. Mohammed. Evaluation of the antidiabetic property of aqueous extract of Mangifera indica leaf on normal and Alloxan-induced diabetic rats. Journal of Natural Product and Plant Resources. 2(2); 2012, 239-243.
- [2] I. U. Muhammad, A. J. Alhassan, M. S. Sule, A. Idi, A. Mohammed, A. B. El- ta'alu, M. A. Dangambo and Y. Abdulmumin. Anti-Hyperglycemic Activity of Solvents Extract of Khayasenegalensis Stem Bark in Alloxan Induced Diabetic Rats. JABB, 6(2): 2016, 1-8.
- [3] WHO. Diabetic. 2015 Available from: www.who.int/mediacenter/factsheets/fs312/en/. Last accessed 30th January 2015.

- [4] Health intelligence. (2013). Prevalence of diabetes in the world. Geneva, World Health Organisation. Available at: <http://healthintelligence.drupalgardens.com/content/prevalence-diabetes-world-2013>. Last accessed 16th march, 2015.
- [5] S. Wild, G. Roglic, A. Green, R. Sicree, and H. King. Global prevalence of Diabetics: Estimate for the year 2000 and projections for 2030. *Diabetes care*, 27; 2004, 1047-1053.
- [6] D. K. Patel, S. K. Prasad, and S. Hemalatha. An overview on antidiabetic medicinal plants having mimetic property. *Asian pac J. Trop. Biomed* 2(4); 2012, 320-330.
- [7] I.K. Obiudu, A.C. Okolie, K.N. Agbafor, M.E. Unaegbu, G.A. Engwa and C.V. Obiudu. Anti-Diabetic Property and Phytochemical Composition of Aqueous and Methanol Extracts of Buchholziacoriacea Seeds in Alloxan-Induced Diabetic Rats. *Journal of Medical Sciences*, 15: 2015, 241-245.
- [8] M. Modak, P. Dixit, J. Londhe, S. Ghaskadbi, A. Paul, and T. Devasagayam. Indian Herbs and Herbal Drugs Used for the Treatment of Diabetes. *Journal of Clinical Biochemistry and Nutrition*, 40(3); 2007, 163–173.
- [9] R. Gupta, B. Gabrielsen, and F. M. Ferguson. Nature's medicines: Traditional Knowledge and intellectual property management. Case study from the National Institute of Health (NIH). *USA Current Drug DiscoveryTechnologies* 2; 2005, 203-219.
- [10] B. H. Chew, S. Shariff-Ghazali, and A. Fernandez. Psychological aspects of diabetes care: Effecting behavioral change in patients. *World Journal of Diabetes*, 5(6); 2014, 796–808.
- [11] S. Pathak, H. C. Dorfmüller, V. S. Borodkin, and D. M. F. van Aalten. Chemical Dissection of the Link between Streptozotocin, O-GlcNAc, and Pancreatic Cell Death. *Chemistry & Biology*, 15(8); 2008, 799–807.
- [12] M. E. Cerf. Beta Cell Dysfunction and Insulin Resistance. *Frontiers in Endocrinology*, 4; 2008, 37.
- [13] S. Oyedemi, E. Adewusi, O. Aiyegoro, and D. Akinpelu. Antidiabetic and haematological effect of aqueous extract of stem bark of *Azelaiafricana* (Smith) on streptozotocin-induced diabetic Wistar rats. *Asian Pacific Journal of Tropical Biomedicine*, 1(5); 2011, 353–358.
- [14] L. C. Perlmutter, B. P. Flanagan, P. H. Shah, and S. P. Singh. Glycemic Control and Hypoglycemia: Is the loser the winner? *Diabetes Care*, 31(10); 2008, 2072–2076.
- [15] M. Bernardi, C. Maggioli, and G. Zaccherini. Human albumin in the management of complications of liver cirrhosis. *Critical Care*, 16(2); 2012, 211.
- [16] A. Mohammed, A.M. Wudil, A. J. Alhassan, A. A. Imam, I. U. Muhammad, and A. Idi. Hypoglycemic Activity of *Curcuma longa* Linn Root Extracts on Alloxan Induced Diabetic Rats. *Saudi J. Life Sci.* 2(2); 2017, 43-49.
- [17] P. K. Dabla. Renal function in diabetic nephropathy. *World Journal of Diabetes*, 1(2); 2010, 48–56.
- [18] M. Demir, C. Demir, U. Uyan, and M. Melek. The Relationship Between Serum Bilirubin Concentration and Atrial Fibrillation. *Cardiology Research*, 4(6); 2013, 186–191.
- [19] N. Gupta, T. Singh, R. Chaudhary, S. K. Garg, G. S. Sandhu, V. Mittal, and S. Sule. Bilirubin in coronary artery disease: Cytotoxic or protective? *World Journal of Gastrointestinal Pharmacology and Therapeutics*, 7(4); 2016, 469–476.
- [20] M. Femlak, A. Gluba-Brzózka, A. Ciałkowska-Rysz, and J. Rysz. The role and function of HDL in patients with diabetes mellitus and the related cardiovascular risk. *Lipids in Health and Disease*, 16; 2017, 207.
- [21] S. Gowda, P. B. Desai, V. V. Hull, A.A.K. Math, S. N. Vernekar, and S.S. Kulkarni. A review on laboratory liver function tests. *The Pan African Medical Journal*, 3; 2009, 17.
- [22] M. Music, A. Dervisevic, E. Pepic, O. Lepara, A. Fajkic, B. Ascic-Buturovic, and E. Tuna. Metabolic Syndrome and Serum Liver Enzymes Level at Patients with Type 2 Diabetes Mellitus. *Medical Archives*, 69(4); 2015, 251–255.

IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB) is UGC approved Journal with Sl. No. 4033, Journal no. 44202.

Ngwen,A.L " Evaluation Of The Effects Of Methanol Extracts Of Leaf And Stem Bark Of Buchholziacoriaceae (Wonderful Kola) On Some Biochemical Parameters Of Streptozotocin-Induced Diabetic Rats.." *IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)* 4.2 (2018): 01-08.