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Research Article

Biochemical Composition and Effects of Aqueous Extracts of the Leaf, Stem and Root of *Securidaca longipedunculata* Fresen (Violet Tree) on Alloxan Induced Diabetic Rats

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Abstract

Studies were carried out on the effects of aqueous leaf, stem bark and root extracts of *Securidaca longipedunculata*. Fresen (violet tree) on diabetic albino rats. The powdered plant parts were extracted using water as solvent and using maceration method. The qualitative and quantitative analysis of the biochemical components of the plant parts were carried out using standard methods. The acute toxicity study was conducted using 24 albino rats for each plant part. The effects of aqueous leaf, stem bark and root extracts of *S. longipedunculata* (200 mg/kg) on blood glucose in normoglycemic and alloxan diabetic rats were also investigated using 25 albino wistar rats. Two mls of each of the extracts were administered orally twice daily for 3 weeks after diabetic induction and the blood glucose level was measured on daily basis using On-call-plus glucometer. The hypoglycemic activity was evaluated by comparing the initial blood glucose level with that of the treated and standard. The screening of the aqueous extracts of the plant parts for biochemical composition revealed the presence of some secondary metabolites of pharmacological significance including alkaloids (15-18.40 mg/kg), cardiac glycosides (23.30-26.10 mg/kg), flavonoids (23.58-31.05 mg/kg), saponins (215.60-270.59 mg/kg) and tannins (314.76-339.75 mg/kg) with tannins and saponins in larger quantities. The leaf, stem and root extracts were found to have LD_{50} value of 490 mg/kg, 693 mg/kg and 693 mg/kg body weight respectively. The plant part extracts showed significant ($p \leq 0.05$) reduction of Blood Glucose Concentration (BGC) of 3.47, 3.96 and 4.03 mmol/dl for leaf, stem bark and root extracts respectively after the treatment period indicating that *S. longipedunculata* has hypoglycemic activity.

Keywords: *Securidaca longipedunculata;* Biochemical Components; Diabetic; Albino Rats; Extracts

Introduction

Diabetes mellitus is a chronic disorder that occurs when the body is unable to produce or respond to insulin, a hormone that allows blood glucose to enter the cells of the body and generate the body's energy. Diabetes as a metabolic disorder occurs when the pancreas fails to produce enough insulin or when the body cells could not respond to the insulin produced by the pancreas and maintains blood sugar level over a prolonged period [1]. Currently diabetes affects 422 million people worldwide [2] which shows that approximately 3% of the world population have been affected by the disease. In 2015, "diabetes was the direct cause of 1.6 million deaths in the world and about 425 million people have diabetes in the world" [3]. It was also reported that in 2015, about 2.0% of the adults in Nigeria have diabetes. This amounts to about 1,702,900 cases of diabetes. "Symptoms of high blood sugar include frequent urination, increased thirst and increased hunger" [4]. Diabetes if not treated well can cause many other complications. The symptoms of untreated diabetes as reported by Cooke and Plotnick [5] included "weight loss, polyuria (increased urination), polydipsia (increased thirst) and polyphagia (increased hunger) and symptoms may develop rapidly (weeks or months) in type 1 diabetes mellitus, while they usually develop much more slowly and may be subtle or absent in type 2 diabetes mellitus". The authors also reported that several other signs and symptoms can mark the onset of diabetes and include blurry vision, excessive loss of weight, headache, fatigue, itchy skin and slow healing of wounds or wounds refusing to heal. However, prolonged high blood glucose can cause the lens of the eye to absorb glucose, resulting in changes in its shape and changes in vision. Skin rashes that occur in diabetic conditions are collectively known as diabetic dermadromes [6].

Securidaca longipedunculata (Family: Polygalaceae) is a plant with several uses in African traditional medicine for treating diseases such as various sexually transmitted infections, snake bites, hernias, coughs, fever, anti-helmintic, inflammation, arthritis, skin infections and others. it is also employed as an aphrodisiac for men [7]. The Iringa people of Tanzania employ it for the management of some non-insulin dependent diabetes. *S. lonpipedunculata* is known in Nigeria with common names like; violet tree (English), Uwarmaganigunar (Hausa) which means mother of all drugs, Ezeogwu (Igbo) and Ipeta (Yoruba). The plant is a medium sized violet tree, growing up to 6-12 m height, with a characteristic pale smooth stem bark. Leaves of *S. longipedunculata* are of varying sizes and shapes, alternate in arrangement and sometimes spine-tipped. The plant presents fine hairs at early stage which they lose when they are matured. Flowers are in short bunches are always pink or purple in colour and are sweet scented [8].

Plate 1: *Securidaca longipedunculata.*

The uses of this plant, *Securidaca longipedunculata* include a great variety. There are several uses of the plant both medically and otherwise around African continent. It was reported that it can be used to treat ailments as little as headaches or as severe as inflammatory conditions. It has been known to possess molluscicidal properties as a result of its saponins component. The plant has pesticidal activity against beetles in stored grains. This could be very helpful for small-scale subsistence farmers in Africa who cannot afford expensive synthetic pesticides. Ojewole [7] reported that "the roots of the tree can be used for treatments of human ailments such as coughs, chest pains, toothaches, fevers, constipation, diabetes and microbial infections. It also possesses anti-inflammatory properties that help to reduce arthritis pains". It has been reported that the methanol extract and the methyl salicylate component of the roots of *S. longipedunculata* produce a potent fish poison and the poison is also used on arrows for hunting in the wild [9]. Yang., *et al*. [10] reported that "The genus *Securidaca* comprises about 80 species, characterized by papillionaceous purplish flowers which produce compounds known as securixanthones with antimicrobial and antioxidant properties". Diabetes is eating deep into the society and there is

urgent need to search for novel antidiabetic drugs from medicinal plants or herbal sources. The existing synthetic drugs are now developing resistance and side effects due to long-term use. Scientists are in search of bioactive compounds that could aid in the development and production of novel drugs with hypoglycemic effects that may control diabetes with little or no side effects. The paucity of information on the use of *S. longipedunculata* and the claims by herbal medical practioners spurred the authors to carry out this research work.

The main aim of this study was to evaluate various biochemical constituents and hypoglycemic effects of aqueous leaf, stem bark and root extracts of *Securidaca longipedunculata* on animal models.

Materials and Methods

Determination of the biochemical composition of the extracts

Determination of the qualitative biochemical composition of the extracts

Phytochemical screening of the extracts was done employing standard methodologies. The tests carried out included those for alkaloids, cardiac glycosides, saponins, tannins and flavonoids, anthraquinones, steroids, and carbohydrates [11-14].

Determination of the quantitative biochemical composition of the extracts

Determination of alkaloids content

The total alkaloids content of the aqueous extract of *S. longipedunculata* was determined according to the modified method of Biradar and Racheti [15]. A weight of 5 g of each sample was added to 50 ml of a solution containing 10% acetic acid in ethanol and were mildly stirred for 48 hours. The resultant mixture was filtered. The extracts were concentrated to one-quarter of the original volume and 2 ml of 3% sulphuric acid and 8 ml of water were added to bring the pH to 2.5. This solution was transferred to a separator funnel and a volume of 10 ml of petroleum ether: diethyl ether (1:1) solution was added. The bottom phase was collected and added to ammonium hydroxide solution until precipitate was completely formed (pH 8.0). The solution was allowed to settle and the precipitated phase was collected and washed severally with ammonium hydroxide and chloroform. The precipitated phase was dried first with sodium sulphate and was then completely dried by rotavapor and weighed to estimate the percentage of alkaloids obtained.

Determination of tannins content

About 2 g of each sample was extracted for 20 hours with anhydrous ether. The resultant residue was boiled in 300 ml water for 2 hours then cooled. It was diluted to 500 ml and filtered. About 25 ml volume of this infusion was measured into 2 L porcelain dish; a volume of 20 ml indigo solution was added and also 750 ml water. One ml of standardized potassium permanganate solution was added gradually at a time until the blue solution changes to green. Then few drops of standardized potassium permanganate solution were added more at a time until solution becomes golden yellow. The mixture of 20 ml Indigo solution was then titrated with 750 ml water; difference in two titrations was multiplied to obtain Quercitannic acid [16].

Determination of flavonoids content

A weight of 1 g of each of the sample was weighed and repeatedly extracted with 100 cm^3 of 80% methanol at room temperature. The mixture was then filtered through into a 250 cm^3 beaker using filter paper. The filtrate was evaporated to dryness using water bath at 60°C. The resultant extracts were weighed and the percentage (%) flavonoids were calculated [17].

Determination of cyanogenic glycosides (cyanide) content using alkaline titration method

No. 20 sieve was used to sieve about 10-20 g portion of each ground sample into 80 ml Kjedahl flask. A volume of 200 ml distilled water was added and was allowed to stand for 2 to 4 hours (Autolysis was conducted with apparatus completely connected for steam distillation). A volume of 150 to 160 ml distillate was collected in NaOH solution (0.5g in 20 ml water), and then diluted to definite volume (250 ml). About 100 ml of the distillate was titrated by adding 8 ml of 6M NH_4OH. Also add 2 ml of 5% KI solution and titrate with 0.02M $AgNO_3$ using micro burette. Permanent turbidity was observed especially against black background [18].

Determination of saponins content

The percentage yield (%) of the total saponins content was determined by gravimetric method as described by Kaur., *et al*. [19]. A weight of 1 g in 10 ml of methanolic extract of each plant part was macerated for 24 hours and then partitioned in a water and n-butanol (1:1 ratio) solution. The solution was poured into a separator funnel and was allowed to stand for 2 hours. The upper n-butanol layer was separated and the solvent was evaporated to obtain crude saponins extract which was measured and calculated.

Collection of drugs and other chemicals

Alloxan monohydrate was purchased from Sigma Co., USA, Metformin (Glucophage 500 mg) was procured from a local pharmacy shop in Jos, Plateau State, Nigeria. The other chemicals such as the solvents and reagents used were of analytical grade obtained from reputable vendors.

Collection and processing of the plant materials

The preparation of the plant materials was done according to the methods of Okeke and Elekwa [20]. The fresh leaves, stem and roots of *Securidaca longipedunculata* were collected during the month of August, 2021 between the hours of 7am-10am GMT at Shere Hills, Jos, Plateau State, Nigeria. The plant was identified and authenticated by Mr. J. J. Azila in the Herbarium of Federal College of Forestry, Jos, Plateau State, Nigeria. The plant materials were properly dried. The dried samples were then pulverized to powdered forms. Two grammes of each of the samples were weighed into separate beakers containing 10 mls of distilled water and were stirred properly. The beakers were left to stand under room temperature for 24 hours. They were filtered with Whatman No 1 filter paper to obtain an aqueous solution. The resultant crude extracts were stored in clean airtight sample bottles in a refridgerator (4°C) prior to use. Fresh crude extracts were prepared each two days.

Determination of acute toxicity (LD_{50}) of the extracts

The acute toxicity (LD_{50}) of the extracts were carried out using the method of Lorke [21]. For each of the plant part extract, twenty-four albino rats were used for the acute toxicity test in determining the LD_{50} in two phases. The initial phase employed twelve rats which were divided into four groups of 3 rats each. The first group that was given distilled water only served as control. Groups 2, 3 and 4 were orally treated with 10, 100 and 1000 mg/kg body weight of the extract respectively. Each of the rats was given a dose after 5 days of adaptation and acclimatization. The rats were observed for 24 hours for any mortality. In the second phase, the rats were grouped into four of one rat each and treated (orally) with the extract at varying doses (200, 400, 600 and 800 mg/kg) per body weight. The animals were observed for any death within 24 hours and the final LD_{50} value was determined and recorded.

Experimental animals and study protocol

Twenty-five albino rats (Wister stock) were obtained from Animal unit of Department of Pharmacology, Faculty of Pharmaceutical Sciences, University of Jos, Nigeria. The animals were maintained under standard laboratory conditions (temperature 25 ± 2°C; RH 50 ± 5%; 12 hrs light/dark cycle) and were fed on normal rodent diet specially prepared from chick Grower's mash and were given water *ad libitum* throughout the study period. All rats were acclimatized for 4 days in laboratory conditions before start of experiment. As at the starting of the experiment, animals' weights were taken and they ranged between 100-150 g.

The experiment was designed to access the effects of 200 mg/kg body weight of aqueous leaf, stem and root extracts of *Securidaca longipedunculata* on alloxan diabetic rats. The animals were divided into five groups (A-E) with each group containing five animals. Group A (control) were treated with only distilled water. Group B (control) were induced with alloxan (150 mg/kg body weight) and treated with metformin (100 mg/kg). Groups C, D and E were induced with alloxan and treated with leaf, stem and root extract (200 mg/kg body weight respectively) via gavage technique (oral route) for 3 weeks [22]. All treatments were carried out up to 3 weeks (21 days). The animals in the first group were administered water simultaneously for 3 weeks.

Collection and analysis of blood samples for blood glucose concentration

At the end of the treatment period, the concentration of blood glucose of the diabetic rats was determined employing the method of Baker., *et al*. [23]. The tail of each of the rat was cut at the tip aseptically with the aid of a new sterile razor blade after swabbing with methylated spirit. Drop of blood from the tip of the tail was placed on the sensor of the blood glucose test strip. The test trip was inserted into the on-call-plus glucometer with an arrow indicating ready for use. The readings for the Blood Glucose Concentration were recorded in triplicates. The test was carried out in the morning by 8 am before the rats were fed after 12 hours of not eating.

Results

The biochemical composition of plant parts of *Securidaca longipedunculata*

The qualitative screening for the biochemical constituents as shown in Table 1 revealed that the leaf, stem and root of *Securidaca longipedunculata* contained saponins, tannins, cardiac glycosides, alkaloids and flavonoids. Anthraquinones was found only in the leaf

and stem while it was absent in the root extract. Carbohydrates and steroids were completely absent in the three plant parts extracts.

The results of the quantitative screening of the biochemical constituents of the plant parts extracts as presented in Table 2 showed a significant difference ($p \leq 0.05$) amongst the constituents. The biochemical constituents from aqueous root extract exhibited highest mean values of *S. longipedunculata* and the order of quantitative estimation are total tannins (339.75%) > saponins (270.59%) > flavonoids (31.05 %) > cardiac glycosides (23.89 %) > alkaloids (15.00%). This was followed by combined performance of biochemical constituents from aqueous stem bark extract and the order of increase are total tannins ((315.36 %) > saponins (238.79 %) > flavonoids (28.78 %) > cardiac glycosides (26.10 %) > alkaloids (18.40 %). biochemical constituents from aqueous leaf extract exhibited least trend on increase and the order of performance are also total tannins (314.76 %) > saponins (215.60 %) > flavonoids (23.58 %) > cardiac glycosides (23.30 %) > alkaloids (15.03 %).

Acute toxicity (LD_{50}) test

The LD_{50} value of the plant parts extract was determined at 490 mg/kg, 693 mg/kg and 693 mg/kg for leaf, stem bark and root extracts respectively as shown in Tables 3a-3c.

Blood glucose concentration

The results of the blood glucose concentration of the experimental albino rats before and after treatments are presented in Table 4 showing the mean effect of blood glucose levels of experimental rats that received different treatments after induction with alloxan monohydrate including distilled water (Group A), Metformin (Group B), 200 mg/kg b. w. aqueous leaf, stem and root extracts (Group C-E) respectively. The results of the mean effects of blood glucose levels of experimental rats treated with distilled water thus revealed a significant difference ($p \leq 0.05$) amongst the glucose level when compared with the standard and the highest value for each level was obtained at 72 hrs after induction with Alloxan. It was observed that the blood sugar level increased to 6.78 mmol/dL. The treatment with distilled water did not have any effect on the blood glucose level of the group. The mean effects of blood glucose levels of experimental rats treated with metformin (control group) revealed a significant difference ($p \leq 0.05$) amongst the glucose level when compared with the standard and the highest value for each level was obtained at 72 hrs after induction with Alloxan (Table 4). After induction, it was observed that the blood sugar level increased to 7.06 mmol/dL but after treatment the blood sugar came down to 3.91 mmol/dL.

The mean effects of blood glucose levels of experimental rats treated with plant leaf extract of *S. longipedunculata* showed a significant difference ($p \leq 0.05$) amongst the glucose level when compared with the standard and the highest value for each level was obtained at 72 hrs after induction with Alloxan the blood sugar level increased to 7.74 mmol/dL after induction but after treatment the blood sugar came down to 3.97 mmol/dL. In the same manner, the mean effects of blood glucose levels of experimental rats treated with stem bark extract of *S. longipedunculata* revealed a significant difference ($p \leq 0.05$) amongst the glucose level when compared with the standard and the highest value for each level was obtained at 72 hrs after induction with Alloxan. the blood sugar level increased to 8.22 mmol/dL but after treatment the blood sugar came down to 3.96 mmol/dL. The mean effects of blood glucose levels of experimental rats treated with root extract of *S. longipedunculata* revealed a significant difference ($p \leq 0.05$) amongst the glucose level when compared with the standard and the highest value for each level was obtained at 72hrs after induction with Alloxan. the blood sugar level increased to 7.87 mmol/dL but after treatment the blood sugar came down to 4.03 mmol/dL (Table 4).

Biochemical Constituent	Leaf	Stem	Root
Saponins	+	+	+
Tannins	+	+	+
Anthraquinones	+	+	-
Cardiac glycosides	+	+	+
Alkaloids	+	+	+
Flavonoids	+	+	+
Carbohydrates	-	-	-
Steroids	-	-	-

Table 1: Biochemical Constituents of Aqueous Leaf, Stem and Root Extracts *S. longipedunculata.*

+ = Present - = Absent.

Phytochemical constituents (%)	SD ± Mean
Alkaloids	0.19 ± 15.03[d]
Total Tannins	8.81 ± 314.75[a]
Saponins	1.09 ± 215.60[b]
Flavonoids	0.46 ± 23.58[c]
Cardiac Glycosides	0.49 ± 23.30[c]
SE	1.99
p-value	0.000

Table 2: Mean Quantitative estimation of some Phytochemical constituents from the aqueous leaf extract of *S. longipedunculata.* Values (in the same column) with the same subscript letters do not differ significantly from each other according to the Duncan multiple range test.

(a)		
Doses (mg/kg)	**No of Treated rats**	**No of Dead rats after 24 hrs**
Control (Distilled water)	3	0/3
10	3	0/3
100	3	3/3
1000	3	0/3
(b)		
Doses (mg/kg)	**No of Treated rats**	**No of Dead rats after 24 hrs**
200	3	0/3
400	3	0/3
600	3	3/3
800	3	3/3

Table 3a: Lethal Dose (LD_{50}) of the Aqueous Leaf Extract of *Securidaca longipedunculata.*

n = number of rats per group.

$$LD_{50} = \sqrt{600} \times 800$$

LD_{50} (Oral) = 490 mg/kg

(a)		
Doses (mg/kg)	**No of Treated rats**	**No of Dead rats after 24 hrs**
Control (Distilled water)	3	0/3
10	3	0/3
100	3	0/3
1000	**3**	3/3
(b)		
Doses (mg/kg)	**No of Treated rats**	**No of Dead rats after 24 hrs**
200	3	0/3
400	3	0/3
600	3	0/3
800	3	3/3

Table 3b: Lethal Dose (LD_{50}) of the Aqueous Stem Extract of *Securidaca longipedunculata.*

n = number of rats per group.

$$LD_{50} = \sqrt{600} \times 800$$

LD_{50} (Oral) = 693 mg/kg

(a)		
Doses (mg/kg)	**No of Treated rats**	**No of Dead rats after 24 hrs**
Control (Distilled water)	3	0/3
10	3	0/3
100	3	0/3
1000	3	3/3
(b)		
Doses (mg/kg)	**No of Treated rats**	**No of Dead rats after 24 hrs**
200	3	0/3
400	3	0/3
600	3	0/3
800	3	3/3

Table 3c: Lethal Dose (LD_{50}) of the Aqueous Root Extract of *Securidaca longipedunculata.*

n = number of rats per group.

$$LD_{50} = \sqrt{600} \times 800$$

LD_{50} (Oral) = 693 mg/kg

	Blood	Glucose Level	(mmol/dL)		
Treatment	**Control Group (Water) A**	**Control Group (Metformin) B**	**Leaf Extract C**	**Stem Bark Extract D**	**Root Extract E**
Before induction of Alloxan	0.07 ± 3.95^{c}	0.06 ± 3.96^{c}	0.25 ± 3.89^{d}	0.24 ± 3.91^{c}	0.08 ± 4.10^{c}
72hrs after induction of Alloxan	0.06 ± 6.78^{a}	0.11 ± 7.06^{a}	0.32 ± 7.74^{a}	0.67 ± 8.22^{a}	0.16 ± 7.87^{a}
After treatment	-	0.22 ± 3.91^{d}	0.36 ± 3.97^{c}	0.11 ± 3.96^{c}	0.10 ± 4.03^{c}
R/standard x conc. of standard	0.51 ± 5.32^{b}	0.07 ± 5.51^{b}	0.17 ± 5.71^{b}	0.17 ± 5.71^{b}	0.15 ± 5.77^{b}
SE	0.13	0.04	0.13	0.17	0.06
p-value	0.000	0.000	0.000	0.000	0.000

Table 4: Blood Glucose Levels of the Experimental Rats Treated with Plant Part Extract of *Securidaca longepedunculata* (SD ± n = 5).

Mean values (in the same column) with the same subscript letters do not differ significantly from each other according to the Duncan multiple range test.

Discussion

The biochemical analyses on the plant, *Securidaca longipedunculata* indicated that the plant parts contained various biochemicals including saponins, tannins, alkaloids, flavonoids, cardiac glycosides, anthraquinones, though not contained in the root extract and the absence of carbohydrates and steroids in all the three extract. The treatment of diabetes with conventional drugs has been reported to be very expensive and the side effects are reportedly high. Marella [24] reported that "out of the secondary metabolites produced by plants, polyphenols, in particular, flavonoids are suggested as good therapeutic agents in the management of diabetes mellitus and its chronic complications". This report is similar with the findings of this research since flavonoids (23.30, 26.10 and 23.89 mg/kg) were isolated from the leaf, stem and root of *S. longipedunculata* (Table 2). Flavonoids can lower blood glucose in diabetic rats [25] and it works by the repairs of damaged pancreatic beta cells and stimulation of insulin secretion by the pancreatic beta cells. Ajiboye,., *et al*. [26] reported that biochemicals obtained from herbal plants could provide an alternative for the production of new therapeutic agents against the ailment, diabetes mellitus. These biochemicals include flavonoids, tannins, terpenoids, cardiac glycosides, alkaloids, and steroids. Flavonoids have been known to have strong antioxidants potentials. Ghosh., *et al*. [27] studied *Bacopa monnieri* (L.) Wettst. (family: Scrophulariaceae) a creeping herb found across India. The authors reported that "Bacosine, a triterpene isolated from ethyl acetate fraction of *B. monnieri* showed pronounced reduction in blood glucose levels in diabetic rats in a dose-dependent manner and that Bacosine is known to have antihyperglycemic properties rather than hypoglycemic activity". They reported further that "Bacosine works in a way similar to insulin and that its anti-hyperglycemic activity might be attributed to the increase in the consumption of peripheral glucose as well as protect against oxidative damage in alloxan induced diabetes". Also, "several compounds including tetracyclic triterpenoid saponins, Bacosides A and B, Hersaponin, alkaloids viz. Herpestine and Brahmine and flavonoids have been isolated from the plant, *Bacopa monnieri"* [27].

Another bioactive phyto-compound is Charantin which a cucurbitane (triterpenoid) extracted from *M. charantia.* This compound has demonstrated antidiabetic activity and is more effective than tolbutamide which is a standard oral hypoglycemic drug [28]. Two other Saponin compounds, 3-hydroxycucurbita-5, 24-dien-19-al-7, 23-di-O-β-glucopyranoside and Momordicine-II which were extracted from the corolla of *M. charantia* produce antidiabetic activity and have also exhibited insulin-releasing properties in MIN6 β-cells. Al-Amin., *et al*. [29] in their study reported that "several active constituents have been isolated from

Zingiber officinale (Ginger) including gingerols, the shogaols, as well as volatile oils of sesquiterpenes, such as β-bisabolene and monoterpenes, mainly geranial and neral and that 6-shogaol and 6-gingerol can suppress the development of diabetic complications". Other reports indicating anti diabetic effects of active principles from medicinal plants include those of Shibano [30] who isolated radicamines A and radicamines B (alkaloids) *Lobelia chinensis* which exhibited α-glucosidase activity and also demonstrated activity for hyperglycemia. From this research work, the tannins and saponins were reported to be in larger quantities than other active principles isolated. The results of the research work were in consonance with the works of Auwal., *et al*. [31]. The quantities of tannins and saponins obtained could probably be due to the solubility of tannins and saponins in aqueous solution as reported by Tailang and Sharma [32].

The acute toxicity LD_{50} test showed that *Securidaca longipedunculata* was slightly toxic [33] to the laboratory animals following median lethal dose (LD_{50}) values of 490 mg/kg, 693 mg/kg and 693 mg/kg for the aqueous leaf, stem bark and root extracts respectively (Table 3a-3c). The results of the acute toxicity test recorded for this research work was in agreement with the findings of Auwal., *et al*. [31]. However, Lork [21] noted that LD_{50} greater than 5000 mg/kg b. w. is safe. Bulus., *et al*. [34] in their work recorded increased symptoms of toxicity on white albino rats but there was no death at LD_{50} of 5000 mg/kg b. w. of *Terminalia avicennioides* aqueous extract. According to Kagbo and Ejebe [35], acute toxicity test is a very useful tool in determining the safety or toxic potential of a natural product or substance that its toxicity profile has not been elucidated. Yehya., *et al*. [36] indicated that "Preliminary toxicological tests are always necessarily conducted in order to select the safe doses for antidiabetic studies". They went further to report that researches on herbal plants provide window for the evaluation of safety profile of herbal products and for setting up an avenue for mapping a safe dose for use in humans and animals.

There is a growing interest on the use of herbal plants as alternative medical therapies for lowering blood sugar levels in patients diagnosed with diabetes mellitus (DM). The present study assessed the effects of aqueous leaf, stem bark and root of *S. longipedunculata* on diabetic albino rats. The normoglycemic rats were induced for diabetes using alloxan monohydrate within 72 hrs. Alloxan is a known inducer of hyperglycemia solely by destroying pancreatic β-cells through redox-mediated mechanisms. 'This auto-oxidation of glucose in hyperglycemic condition can trigger lipid peroxidation and changes in antioxidant defense mechanisms which could lead to dysfunctions metabolism of glucose" [37]. Metformin which was employed as a standard drug is a biguanide its duty is to reduce glucose synthesis in the hepatic cells and also boosting of peripheral insulin sensitivity [38]. Metformin (Glucophage) is an anti-hyperglycemic agent that improves glucose tolerance by lowering basal and postprandial plasma glucose levels in type 2 diabetes [39]. The potentials of herbal medicines in controlling hyperglycemia cannot be over emphasized. Alam., *et al*. [40] reported in their work that plants bioactive compounds can be rely upon as a steppingstone to manufacture new antidiabetic therapeutics to help in treating diabetes and their associated complications. "*In Vitro* preliminary screening of aqueous extract of the leaves of *Securidaca longipedunculata* for anti-hyperglycemic property" was carried out by Onyeche and Kolawale [41]. Our research findings have demonstrated that the aqueous extract of the test plant parts brought about significant lowering of the blood glucose level in the diabetic rats when compared with the standard. Medicinal effects of these plant parts are as a result of the presence of biologically active compounds [42,43]. Flavonoids have been reported to have antidiabetic effects by the enhancement of insulin secretion and insulin mediated glucose uptake by cells after regeneration of pancreatic β-cells [24]. Panda [44] reported that *Moringa oleifera* leaf alcoholic extract contain bioactive compounds like flavonoids, alkaloids, tannins, steroids and glycosides which are effective in treating diabetic complications. Quercetin and kaempferol are two major bioactive constituents which were isolated from *M. oleifera* had found to reduce blood glucose (33.34%) in diabetic rat models in few weeks [45].

Also there have been reports to support the antidiabetic activity of *Vernonia amygdalina* plant parts. Gyang., *et al*. [46] observed that chloroform extract of the plant, *V. amygdalina* has anti-diabetic effect in both normoglycemic and alloxan-induced hyperglycemic rats. Other researchers have reported on the use of herbal plants for hypoglycemic activity [40,42,47-51,53,54]. Diabetes mellitus especially that of Type 2 is characterized by decreased physical activity as well as increased sedentary habits, resulting to elevated systemic inflammation [55].

Conclusion

Aqueous leaf, stem and root extracts of *Securidaca longipedunculata* effectively lowered blood glucose levels in wister albino rats induced with diabetes mellitus. However, further studies are required to elucidate the particular active compound(s) of the biochemicals that are responsible for the anti-hyperglycemic effects of the plant and suggests that the active compounds isolated from the plant used as lead compound for the production of anti-diabetic drugs.

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Conflict of Interest

Authors have declared that no competing interests exist.

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