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ARTICLE

Phytochemical, Proximate and *in-vivo* hypoglycemic Potential of *Synsepalum dulcificum* for Management of *Diabetes mellitus* in Nigeria

Temitope O. Onuminya[1]*, Anita K. Asekunowo[2], Folakemi M. Ifelaja[1] and Oluwatoyin T. Ogundipe[1]

[1]Department of Botany, Faculty of Science, University of Lagos, Lagos, Nigeria
[2]Department of Chemistry Faculty of Science, University of Lagos, Lagos, Nigeria

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**Corresponding author*
Temitope O. Onuminya *E-mail: tadeyemi@unilag.edu.ng, Tel: +2347030241452*

Abstract

Synsepalum dulcificum, a potent natural sweetener, is notably used in the traditional treatment of *Diabetes mellitus* in Nigeria though scientific explanation for its use is not well known. In this study, the phytochemical, proximate and hypoglycemic potential of the leaf and stem extracts (ethanol and aqueous) of *S. dulcificum* were investigated. The phytochemical and proximate analysis were carried out using a standard protocol. In-vivo assay protocols on alloxan-induced diabetic albino rats was followed in determining the hypoglycemic potentials of the extracts (concentrations: 100 mg/Kg, 200 mg/Kg, 400 mg/Kg), using glibenclamide as a standard drug. The aqueous leaf extract gave a higher yield (19.67%) compared to ethanolic extract (17.15%). Phytochemical analysis revealed the presence of flavonoids, saponins, terpenoids, tannins, phenols, steroids, cardiac glycosides and alkaloids in varying degrees in the plant's parts. Proximate analysis showed higher lipid (23.30%) and protein (12.94%) in leaves and higher fibre content in stems (30.00%). The aqueous leaf extract at a high dose (400 mg/kg) gave the best glucose lowering effect (66.67 mg/dL) compared to the medium dose (78.33 mg/dL) and the standard drug (70.00 mg/dL). The albino rats were unable to survive at the lower dose (100 mg/kg) of all the extracts. The observed hypoglycemic effect of the aqueous leaf extract may be linked to significant tannins, flavonoids and saponins in the extract, as these phytochemicals have been reported to exhibit blood sugar lowering potentials. The results from this study confirmed that the leaf aqueous extract as a potential anti-diabetic agent and justified the folkloric use of *Synsepalum dulcificum* in the management of *diabetes mellitus* in Nigeria.

Keywords: *Synsepalum dulcificum*, drug-plants, medicinal plants, pharmacopoeia, metabolites, hypoglycemia,

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Introduction

Diabetes mellitus (DM) is a heterogeneous group of a complex metabolic disorder associated with high blood glucose concentration (hyperglycemia) and alteration in the breakdown of major macromolecules as a consequence of deficiencies in the secretion of insulin or its action (Punithavathi et al., 2011). This metabolic chaos is tied to reduced life expectancy and high morbidity due to its micro-vascular complications (hypertension, stroke and peripheral vascular disease), as well as reduced quality of life (Muriira, 2014).

World Health Organization (WHO) have reported the frightening increase of this menace to about 422 million globally in 2020, mostly in low- and middle-income countries, resulting to about 1.6 million deaths yearly. There are two forms of DM, the most prevalent is Type 2 diabetes which affects mainly adults due to their inability to produce sufficient insulin or when the body becomes resistant to insulin. The 2nd is juvenile diabetes, which is categorized as Type 1 diabetes also known as insulin-dependent diabetes, a chronic disorder in which the pancreas supplies insufficient or no insulin on its own (WHO 2021, Puig-Domingo et al., 2021). A promising approach for the management of diabetes is decreasing postprandial hyperglycemia by inhibiting carbohydrate hydrolyzing enzymes in gastrointestinal tract, particularly in type 2 diabetes (Shim et al., 2003). The use of insulin injection and other synthetic drugs have also been employed in management of diabetic mellitus but there are a number of side effects associated with these. Hence, there is a need for alternative remedy from medicinal plants.

Synsepalum dulcificum (Schumach. and Thonn.) Daniell, formerly known as *Sideroxylon dulcificum* or *Bumelia dulcificum*, is a medicinal plant from tropical West Africa (Achigan-Dako et al., 2015, Hai, 2016) commonly taken as a sugar substitute due to its miraculin composition. It is an evergreen tree (commonly known as the miracle berry plant) that grows best in a warm and moist environment. The plant prefers a slightly acidic soil (pH 4.5-5) and produces edible fruits after 3 years of planting (Khairnar et al., 2022). The fruit is "in season" from May to September, though berries are generated year-round (Sabel, 2012). According to Msora-Kasago, (2021), all parts of the plant are useful in traditional medicine being used in treatment of diabetes, asthma, hyperthermia, gonorrhea, tuberculosis, male infertility, cancer, enuresis (bedwetting), in postnatal care, and as a natural tooth brush.

Several researchers have reported nutritional profile of *S. dulcificum* including Awotedu and Ogunbamowo (2019) however most of these have focused on the fruit of the plant. The presence of phytochemicals such as flavonoids, tannins, resins, steroids and alkaloids were reported in the pulp of *S. dulcificum* berry by Njoku et al. (2016). Also, proximate analysis confirmed significant quantities of carbohydrate, lipid and protein with lower moisture content than those found in other berries. Similarly, Agbessi et al. (2017) discovered that the small oval-shaped wild berry of *Synsepalum dulcificum* contains varying proportions of proteins, fats, carbohydrates, dietary fiber, highly reactive polyphenol compounds, major minerals such as K, P, Ca, Na and Mg; and traces of heavy metals such as Pb, Cu, Cd and Ni. Extract of the plant is used in medical industries in the treatment of cancer, diabetes, malaria, hyperthermia, enuresis, stomach ache, anemia, obesity, cough, tuberculosis and in prostate ailment treatments (Achigan-Dako et al., 2015; Fandohan et al., 2017).

The hypoglycemic effects of the fruit and leaf extracts of *S. dulcificum* on the blood glucose level of alloxan-induced albino rats has been reported by Dioso et al., (2016) who stated that 50% and 100% concentrations of these extracts significantly lowered the blood glucose level of the test rats and related it to the presence of miraculin, flavonoids and saponins present in the plant. Similarly, Obafemi et al., (2019) reported that oral administration of both methanolic and flavonoid-rich leaf extracts of *S. dulcificum* on fructose-fed, streptozotocin-injected rats for 21 days significantly improved the biochemical and pathological alterations in type 2 diabetes. Huang et al. (2020), also reported the cholesterol lowering activity of *S. dulcificum* fruits. More recently, Gomez et al. (2022), reported that the plant can help to reduce the metabolic stress associated with chronic diseases, such as obesity, metabolic syndrome, diabetes, and cancer.

In this study, the aqueous and ethanol extracts of stem and leaf of *S. dulcificum* were investigated for their phytochemical, proximate and antidiabetic potentials.

Experimental

Plant Collection and Authentication: The leaves and stem of *S. dulcificum* were collected from the nursery building of Cocoa Research Institute of Nigeria (CRIN), Idi-Ayunre, Ibadan (Long 07.20760° N and Lat 003.85166° E) as well as on Ajala farm (Long 07.24446° N and Lat 003.81851° E), Lagos-Ibadan expressway, opposite The Technical University, Oyo state. Samples were then taken to the Lagos Herbarium (LUH) for authentication.

Preparation of Plant Extract: Fresh leaves and stems of *S, dulcificum* were washed and air-dried at room temperature for 5 days and 14 days respectively. These were pulverized to coarse powder and 100 g of each plant parts was macerated with absolute ethanol for 72 h to obtain the alcohol extract; and lukewarm distilled water for 12 h to obtain the aqueous extract. The ethanol extract was concentrated to dryness in rotary evaporator at 37^{o} C, while water extract was freeze dried. The extracts were kept at 4^{o} C until use.

Phytochemical Analysis: The methods of Trease & Evans (2009) and Asekun et al., (2013) were adopted in screening the leaf and stem extracts of *S. dulcificum* for the presence of alkaloids, flavonoids, tannins, phenols, terpenoids, saponins, steroids and cardiac glycosides.

Proximate Analysis: The protocols of the Association of Official Analytical Chemist (A.O.A.C., 1990) were adopted for determination of the proximate (moisture, ash, crude fibre and crude protein) content of the leaf and stem of *S. dulcificum*. The carbohydrate was calculated using the difference method by subtracting the sum (g/100 g dry matter) of crude protein, crude fat, ash and fibre from 100 g. The caloric value was determined based on the Atwater factor (FAO, 2003).

Test Animals: Forty male albino rats (body weights 95–160 g) were purchased, caged and acclimatized with feed, light and water for 7 days. All animals were exposed to an environment of 12 h light: 12 h dark period, at a room temperature between 23 °C and 25 °C at the Animal House, College of Medicine, University of Lagos, Nigeria. The experimental procedures adopted were in accordance with the provisions of the Experimentation Ethics Committee on Animal Use of the College of Medicine, University of Lagos, Lagos, Nigeria (CM/COM/08/VOL.XXV) and the United States National Academy of

Sciences Guide for the Care and Use of Laboratory Animals (NIH, 1985).

Determination of blood glucose level: Blood samples were collected from the tail vein of the rats and the blood glucose level was checked prior to the experiment using a glucometer (Accu-Chek®Performa).

Induction of Experimental Diabetes: Rats were induced by injection of alloxan intravenously. The acclimatized rats were fasted for 29 h with free access to water, and then injected with 1 g of alloxan monohydrate dissolved in 10ml of distilled water at a dose of 150 mg/kg per body weight. After 48 h of stability, the blood glucose levels of the animals were checked and animals with blood glucose levels of above 200 mg/dL were considered diabetic and selected for the study.

Treatment of hyperglycemic rats with extracts of S. dulcificum: The diabetic animals were allocated into test and control groups. Normal saline was administered in place of water for the first 5 days of treatment. The test groups consist of:

Group-O: animals injected with alloxan and subcutaneously administered with Glibenclamide (a standard drug) at a dose of 0.6 mg/kg

Group-I: animals were free to access drinking water and food; they were neither injected with alloxan nor fed on plant extract.

Group-II: animals were injected with alloxan and kept as diabetic control.

Group-III, IV and V: animals were injected with alloxan and orally administrated with aqueous leaf extract of *S. dulcificum* at 400 mg/kg (high dose), 200 mg/kg (medium dose) and 100 mg/kg (low dose) daily.

Group-VI, VII and VIII: animals were injected with alloxan and orally administrated with ethanolic leaf extract of *S. dulcificum* at 400 mg/kg (high dose), 200 mg/kg (medium dose) and 100 mg/kg (low dose) daily.

Group-IX, X and XI: animals were injected with alloxan and orally administrated with ethanolic stem extract of *S. dulcificum* at 400 mg/kg (high dose), 200 mg/kg (medium dose) and 100 mg/kg (low dose) daily.

Oral glucose tolerance curve: The body weight of the animals in all the groups were recorded weekly and expressed as mean ± standard error of the mean (SEM) of the body weights. The variance value was tested at $P< 0.05$, $p< 0.01$and $p<0$ significant levels. Blood samples were collected from the tail vein and the blood glucose level was checked at the end of the experiment using a glucometer (Accu-Chek®Performa).

Statistical analysis: Data obtained were presented as mean ± standard error of the mean (SEM). Data generated were analyzed using IBM SPSS v27 (IBM Corp., NY, USA). Data were subjected to Analysis of variance (ANOVA) and the difference in means was considered significant at $p< 0.05$. Dunnett's test was used to compare treatment performance against the standard drug performance. The relationship among variables evaluated was accessed using Spearman's correlation analysis. Graphs was generated using GraphPad Prism v9.5.

RESULTS

Morphological Characterization: Morphologically, *S. dulcificum* is characterized by simple, elongated green leaves that remain green as long as they remain attached to the plant. The leaves have entire margin, pinnate venation generally alternate, acuminate apex, cuneate base and very short petiole. The stem of *S. dulcificum* appear dry with a free branching characteristic that make the tree look like a cone while the moist adventitious root of this plant is buried deep in the soil (Fig. 1). Specimen was authenticated by the curator of the Lagos University herbarium (Dr. G.I. Nodza) and voucher was deposited accordingly (LUH 112343).

Extraction and Phytochemical Screening: Following the extraction procedure, the aqueous leaf extract of *S. dulcificum* yielded more (19.67%) than its ethanolic extract (17.15%) while the ethanolic extract of the stem had the least yield of 6.04%. Phytochemical analysis of the ethanolic extracts of the leaf and stem showed the absence of saponins and the presence of flavonoids, terpenoids, tannins, phenols, steroids and cardiac glycosides in varying concentrations. On the other hand, the aqueous leaf extract showed the absence of terpenoids and alkaloids while the aqueous stem extract showed the absence of flavonoids, saponins and tannins (Table 1).

Proximate Analysis: The proximate analysis showed that the leaf and stem of the plant have an equivalent concentration of carbohydrates and ash; fibres were higher in stem while proteins and lipids were higher in the leaf sample (Table 2).

Induction of Animals and Antidiabetic testing of Plant extracts: After the induction of alloxan, 4 of the test rats died before treatment commenced and all the test rats induced showed a decrease in weight (Table 3). The weight of the animals that were administered the standard drug (positive control group) increased the first week but decreased thereafter.

All the animals in the negative control group (induced but not treated) died as a result of high blood glucose levels. The blood glucose levels of the animals before induction confirmed that the animals were not diabetic. The induction of alloxan raised the blood glucose levels of the animals to well above 300 mg/dL and 600 mg/dL in some (Table 4). The aqueous leaves extract gave the best result at a high dose of 66.67 mg/dL and performed better than the standard drug administered (70.00 mg/dL) (Table 4). The percentage blood sugar lowering effect of the extracts is also presented (Fig. 2).

Statistical analysis of the data obtained showed that there is a correlation between body weight and blood sugar change observed in the animals. As the body weight of animal decreased, the blood glucose level also reduced. This change was significant at $p<0.01$ at Day 7 and $p<0.05$ at Day 14 of the experiments respectively. (Table 5). There is also a significant correlation between the concentration of extracts tested and the blood sugar change recorded at $p<0.01$. The higher the concentration of extract administered, the lower the blood glucose level of the test animal (Table 5).

Discussion

Herbal preparations from all parts of *S. dulcificum* are used in traditional medicine for the management of various human diseases and ailments and the most used plant part is the leaf (Akinmoladun et al, 2020) hence in this study, the hypoglycemic potential of leaf and stem extracts of *S. dulcificum* in alloxan induced diabetic rats was



Figure 1: *Synsepalum dulcificum* (a-b) Live specimen (c-d) Dried specimen (c) leaves (d) stems

Table 1: Phytochemical Compositions of Extracts of *Synsepalum dulcificum* Leaf and Stem

	Leaf		**Stem**	
Phytochemicals	**Aqueous**	**Ethanol**	**Aqueous**	**Ethanol**
Flavonoids	+	++	-	++
Saponins	++	-	-	-
Terpenoids	-	+	+	++
Tannins	++	++	-	+
Phenols	++	+	+	+
Steroids	++	+	++	++
Cardiac glycosides	++	++	+	++
Alkaloids	-	++	+	+

KEYS: ++ = very present. **+ =** present, **-** = absent

Table 2: Proximate Analysis of *Synsepalum dulcificum* Leaf and Stem

Nutrients	Stem (%)	Leaf (%)
Moisture Content	10.00 ± 0.02	6.67 ± 0.01
Lipids	10.00 ± 0.01	23.33 ± 0.05
Fibre	30.00 ± 0.03	15.02 ± 0.01
Ash	5.00 ± 0.02	5.00 ± 0.01
Protein	8.96 ± 0.01	12.96 ± 0.02
Carbohydrate	36.08 ± 0.03	37.06 ± 0.05

*Values represent Mean ± S.D

Table 3: Effect of *Synsepalum dulcificum* Extracts on the Body Weights of the Test Rats

Treatment	BS	BS0	BS14	BSC
T0 (STD)	100.67±0.45	600.00±0.09	70.00±0.14	-530.00±0.24
T1 (NINT)	81.33±0.10	86.66±0.15	98.67±0.09	12.00±0.16
T2 (INT)	129.67±0.09	485.67±0.12	N/A	N/A
Aqueous leaf extract				
T3 (400 mg/kg)	84.33±0.04	600.00±0.06	66.67±0.19	-533.33±0.23
T4 (200 mg/kg)	78.67±0.19	509.67±0.45	78.33±0.22	-431.34±0.23
T5 (100 mg/kg)	79.00±0.00	430.67±0.19	N/A	N/A
Ethanolic leaf extract				
T6 (400 mg/kg)	83.67±0.09	526.33±0.27	78.67±0.19	-447.67±0.31
T7 (200 mg/kg)	76.67±0.19	472.67±0.12	87.00±0.05	-385.67±0.17
T8 (100 mg/kg)	76.67±0.09	403.33±0.15	80.00±0.03	-323.33±0.16
Ethanolic stem extract				
T9 (400 mg/kg)	78.33±0.02	476.00±0.12	79.00±0.08	-397.00±0.13
T10 (200 mg/kg)	78.33±0.20	456.33±0.10	77.67±0.45	-378.66±0.35
T11 (100 mg/kg)	79.00±0.06	400.00±0.29	N/A	N/A

Mean±S.E.M; DAI: days after induction; WC: weight change; T0 (STD): positive control – animals treated with standard drug (Glibenclamide); T1 (NINT): negative control – animals neither induced nor treated; T2 (INT): diabetic control – animals induced but not treated; T3-T11: groups treated with high, medium and low doses of plant extracts

assessed. According to Dioso et al. (2016), plant-derived metabolites in form of crude drugs or isolated compounds have preventive and curative potential in management of *diabetes mellitus* (DM) via anti-oxidative mechanism. The phytochemicals observed in the stem and leaf of *S. dulcificum* (saponins, tannins, flavonoids, phenols, cardiac glycosides, alkaloids, steroids and terpenoids) have been reported to exhibit therapeutic properties in biological systems (Asekunowo et al., 2019, Njoku et al. 2016). Generally, reports on the phytochemicals of *S. dulcificum* have documented different compounds (Akinmoladun et al, 2020). Specifically, flavonoids, tannins and saponins have been reported to exhibit antidiabetic potentials. Flavonoids have been reported to be a potent antioxidant that improves and stabilizes insulin secretion from pancreatic beta cells (Dioso et al., 2016). They have also been found to improve hyperglycemia by increasing glucose uptake in skeletal muscle and white adipose tissue and reducing inflammation and oxidative stress in muscle and fat (Babu et al., 2013). Saponins on the other hand, reduce glucose and cholesterol in the guts, reduce metabolic activities in the liver and inhibit structure-dependent biological activities (Dioso et al., 2016). Phenolic compounds have the capacity to terminate the oxidative reaction caused by free radicals in the pathogenesis of DM. The oxidative reactions exacerbate ageing and initiate array of degenerative diseases such as DM via cell damage or even cell death, reactive oxygen species also initiate insulin resistance (Asekunowo et al., 2019). Tannins on the other hand have been reported to improve diabetic condition by extensively decreasing serum glucose, glycosylated protein and serum urea nitrogen. It also decreases the urinary protein and renal-agenesis in Streptozocin-induced diabetic rats and serum glucose with significant reduction of glycosylated protein in type 2 diabetic mice (Yokozawa et al., 2011). The phytochemical analysis of the leaf and stem of *S. dulcificum* in this study showed that they possess adequate concentrations of phytochemicals needed for the treatment of diabetes.

Table 4: Effect of *Synsepalum dulcificum* Extracts on the Blood Glucose Levels of the Test Rats

Treatment	BS	BS0	BS14	BSC
T0 (STD)	100.67±0.45	600.00±0.09	70.00±0.14	-530.00±0.24
T1 (NINT)	81.33±0.10	86.66±0.15	98.67±0.09	12.00±0.16
T2 (INT)	129.67±0.09	485.67±0.12	N/A	N/A
Aqueous leaf extract				
T3 (400 mg/kg)	84.33±0.04	600.00±0.06	66.67±0.19	-533.33±0.23
T4 (200 mg/kg)	78.67±0.19	509.67±0.45	78.33±0.22	-431.34±0.23
T5 (100 mg/kg)	79.00±0.00	430.67±0.19	N/A	N/A
Ethanolic leaf extract				
T6 (400 mg/kg)	83.67±0.09	526.33±0.27	78.67±0.19	-447.67±0.31
T7 (200 mg/kg)	76.67±0.19	472.67±0.12	87.00±0.05	-385.67±0.17
T8 (100 mg/kg)	76.67±0.09	403.33±0.15	80.00±0.03	-323.33±0.16
Ethanolic stem extract				
T9 (400 mg/kg)	78.33±0.02	476.00±0.12	79.00±0.08	-397.00±0.13
T10 (200 mg/kg)	78.33±0.20	456.33±0.10	77.67±0.45	-378.66±0.35
T11 (100 mg/kg)	79.00±0.06	400.00±0.29	N/A	N/A

Values are presented in Mean±S.E.M; BS: blood sugar before induction; BS0: blood sugar after induction; BS14: blood sugar at the end of treatment; BSC: blood sugar change; PBSC: percentage blood sugar change; T0 (STD): positive control – animals treated with standard drug (Glibenclamide); T1 (NINT): negative control – animals neither induced nor treated; T2 (INT): diabetic control – animals induced but not treated; T3-T11: groups treated with high, medium and low doses of plant extracts

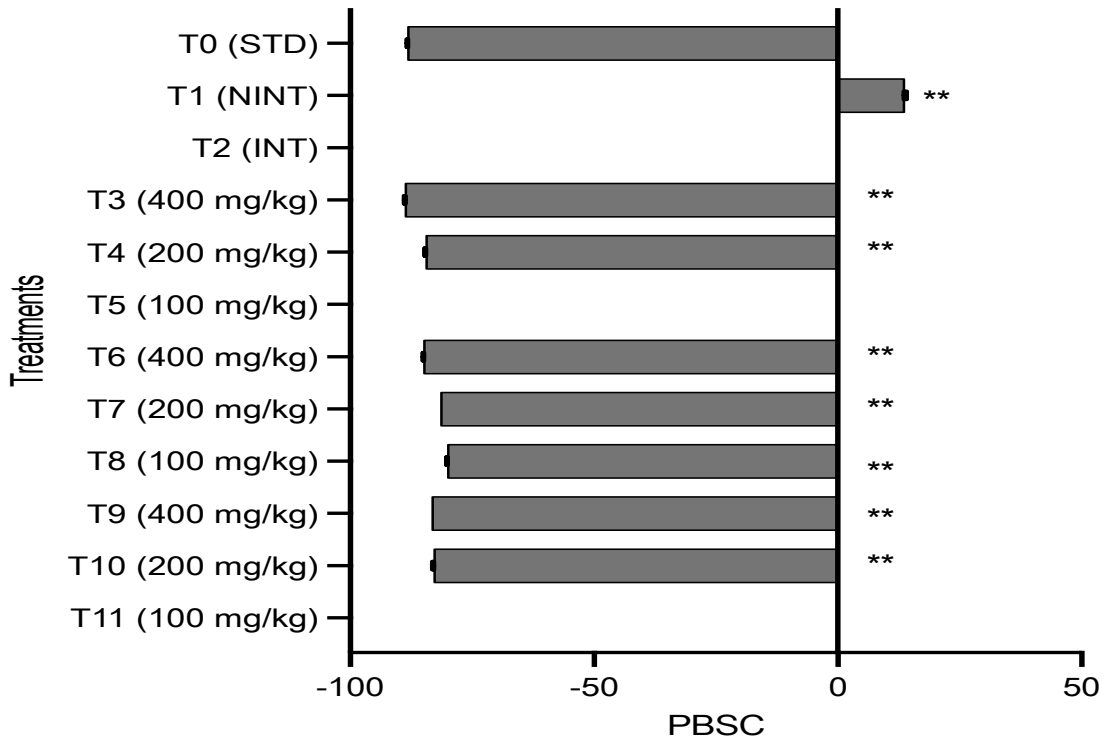


Figure 2: Percentage blood sugar change in diabetic rats treated with *Synsepalum dulcificum* leaf and stem extracts
T0 (STD): positive control – animals treated with standard drug (Glibenclamide); T1 (NINT): negative control – animals neither induced nor treated; T2 (INT): diabetic control – animals induced but not treated; T3-T11: groups treated with high, medium and low doses of plant extracts; PSBC: percentage blood sugar change; **Values significant at $p < 0.01$. NB: All treatments were compared to standard drug

Table 5: Correlation between the body weight and blood sugar of the animals and concentration of extracts of Synsepalum dulcificum at Day 0, 7 and 14 of the experiment

	BW0	BW7	BW14	BS0	BS14	WTC7	WTC14	BSC	pBSC	Conc
BW0	1.00	0.85**	0.54**	-0.46**	0.07	-0.41*	-0.46*	0.35	0.27	-0.07
BW7		1.00	0.86**	-0.59**	0.42*	0.13	0.04	0.44*	0.43*	-0.11
BW14			1.00	-0.44*	0.65**	0.48*	0.35	0.43*	0.48*	0.35
BS0				1.00	-0.78**	-0.05	-0.27	-0.99**	-0.97**	0.89**
BS14					1.00	0.58**	0.68**	0.80**	0.88**	-0.41
WTC7						1.00	0.87**	0.16	0.28	0.16
WTC14							1.00	0.30	0.40*	0.04
BSC								1.00	0.98**	-0.80**
pBSC									1.00	-0.80**
Conc										1.00

Key: **Significant at $p < 0.01$
*Significant at $p < 0.05$
BW0: body weight after induction;
BW7: body weight after 7days induction;
BW14: body weight after 14days induction;
BS0: blood sugar after induction;
BS14: blood sugar at the end of treatment;
BSC: blood sugar change;
PBSC: percentage blood sugar change
WTC7: weight change after 7days induction;
WTC14: weight change after 14days induction
Conc: Concentration of extracts

Nutrition is essential in the management of DM and the *S. dulcificum* has been reported to be nutritionally rich by several researchers including Awotedu and Ogunbamowo (2019). In this study, fibre, protein, carbohydrates and ash content of the leaf and stem of *S. dulcificum* were reported. According to Chandalia et al. (2000), a high intake of soluble dietary fiber enhanced glycemic control and reduced hyperinsulinemia in type II DM patients, besides the envisaged lessening concentrations of plasma lipid. Similarly, Burger et al., (2012) reported that the risk of Type 2 diabetes, heart disease and colon cancer may be prevented by consuming meal rich in fiber, since it processes slowly thereby supporting satiety and maybe less calories. Wendy et al., (2015) opined that protein daily allowance of 20-30% may contribute to increased satiety however too much protein has been reported to cause kidney disease as some amount of protein consumed is converted into blood glucose. Again, the American Diabetes Association (ADA) reported that consuming low carbohydrate diet may help to improve glycemia and exhibit the tendency to decrease anti-hyperglycemic treatments for type 2 diabetic patients (Gray and Threlkeld, 2015). The proximate composition recorded in the leaf and stem of *S. dulcificum* from this study further justified its antidiabetic potential.

Diabetes is a condition that shows a decrease in body weight over time due to excessive loss of body fluid and abnormalities in body metabolism (MNT Editorial Team, 2017). Upon stabilization of alloxan in the test rats, the body weights of all the induced animals dropped. Their body was too weak to stimulate insulin and as a result, glucose present in the body and muscles were used up. After the induction of alloxan, 4 of the test rats died before treatment commenced probably as a result of insufficient insulin necessary to get glucose used for energy from the blood into the body cells. The alloxan-induced hypoglycemic potential of *S. dulcificum* observed from this study revealed that both ethanol and aqueous extracts of the leaf and stem exhibited potent blood glucose-lowering properties at higher concentrations of 400mg/dL and 200mg/dL as compared with the standard drug employed (glibenclamide). The result corroborates the findings of Chen et al. (2006), Dioso et al. (2016), Obafemi et al. (2019), Huang et al. (2020), Khairnar et al. (2022) and Gomez et al. (2022) on the hypoglycemic potential of the fruit and leaf extracts of *S. dulcificum* in the treatment of DM.

The results of this study provide information that *S. dulcificum* exhibit free radical scavenging role in vitro as well as in biological systems. The standard drug, the ethanolic and aqueous extracts of the leaf and stem of *S. dulcificum* has been shown to exhibit hypoglycemic effects on the blood glucose levels of alloxan induced albino rats. Studies on this plant would further affirm its safety as a potential antidiabetic herbal form of treatment.

In conclusion, *S. dulcificum* is indeed a miracle plant as all its part exhibits potent therapeutic properties irrespective of the solvent of extraction. The findings from this study should be added to the pharmacopeia, besides, the need to isolate bioactive compounds that will aid in new drug discovery.

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Declaration of interest statement
The authors declare no conflict of interests.

Author's contribution
The authors' contributions are as follows:
Conception: TOO and OTO
Design: TOO, AKA and OTO
Execution: TOO, AKA and FMI
Interpretation: TOO, AKA and FMI
Writing the paper: TOO and AKA
All the authors have read the final manuscript and approved the submission.

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