ORIGINAL ARTICLE

A C G publications *Rec. Nat. Prod.* 3:4 (2009) 187-192

records of natural products

Anti-diabetic Properties of the Aqueous Leaf Extract of *Bougainvillea glabra* (Glory of the Garden) on Alloxan-Induced Diabetic Rats

Grace I. Adebayo, Oluwakemi T. Alabi, Bamidele V. Owoyele* **and Ayodele O. Soladoye**

Department of Physiology, Faculty of Basic Medical Sciences College of Health Sciences, University of Ilorin, P.M.B. 1515, Ilorin, Nigeria.

(Received April 29, 2009; Revised August 5, 2009; Accepted August 29, 2009)

Abstract: The antidiabetic and antilipidemic effects of *Bougainvillea glabra* was investigated in this study using 25 male wistar rats. The rats were divided into 5 groups comprising of five animals each. These groups include a normal control (administered saline), an extract control (administered 100 mg/kg of extract) and a diabetic control (untreated group). The remaining two groups were administered 100mg/kg and 400 mg/kg of the extract respectively. The study lasted for three weeks although blood samples were obtained from the rat tails after every week. The results show that the extract significantly ($p< 0.05$) reduced the hyperglycaemia from 12±0.40 mmol/L (Diabetic Control) to 4.04±0.03 mmol/L (400 mg/kg group). Likewise, the extract significantly reduced the Total Cholesterol (TC), Triglyceride (TG) and Low-Density Lipoprotein Cholesterol (LDL-Cholesterol), while increasing the High-Density Lipoprotein Cholesterol (HDL-C). In conclusion, the observations from this study show that *Bougainvillea glabra* has antidiabetic effect and beneficial effects on blood lipid profile, thus justifying the use of the plant by traditional medicine practitioners for the treatment of diabetes mellitus.

Keywords: *Bougainvillea glabra;* alloxan-diabetes; hypoglycaemia; hypolipidemia.

1. Introduction

Diabetes mellitus remains a global major health problem in the World over with the tropics inclusive. In the past decade, the United States has recorded a 33% rise in the cases diabetes[1]. Despite the significant achievements in treatment modalities and preventive measures, its prevalence has risen exponentially in the last decade. Because of these limitations, there is continued need for new and more effective therapies which would improve diabetic control and also reduce associated risk

* Corresponding author: E-Mail: deleyele@yahoo.com or deleyele@gmail.com , Phone: +234 803 5065190.

The article was published by Academy of Chemistry of Globe Publications
www.acgpubs.org/RNP © Published 10/04/2009

factors like hyperlipidemia, hypertension and so on. A lot of alternative therapies have emerged with herbal medicine inclusive. This is why the use of herbs has more than tripled over the last 10 years [2].

Herbal therapies such as the Konjac-Mann [3], honey [4,5]. *Azadirachta indica* [6], Glucolevel (a combination of four anti-diabetic plants used in the traditional Arab herbal medicine) [7] have all shown ameliorating effects in the control of hyperglycemia in Diabetes Mellitus.

Bougainvillea (with the common name Glory of the Garden), originated from South America and it is a popular plant in Southern California, Florida, the Caribbean and other areas with tropical and warm climates [8]. It is a thorny woody plant with flowers ranging from pink, purple, red, orange, yellow colours and especially white [9,10]. Among the Bougainvillea's varieties include *Bougainvillea glabra*, *Bougainvillea spectabilis*, and *Bougainvillea harrisi*. *Bougainvillea glabra* is grown for its decorative purposes in tropical regions and in the temperate [8]. In some areas like the Western Europe, North Africa, Middle East and the Indian Sub-continent, *B. Spectabilis*, is used to shorten the life span of sand flies that cause leishmaniasis [11]. *Bougainvillea spectabilis* is also used in herbal combination for the treatment of diabetes [12]. Information also exist about the use of *Bougainvillea glabra* in the cure of ulcer, diarrhoea, and having anti-microbial activities[13]. Information from some traditional medical practitioners show that some beetles that feed on any *Bougainvillea* stems are dried, crushed into powder and added as main ingredient in popular herbal combinations used in the treatment of diabetes mellitus. These herbal formulations are said to be incomplete without the *Bougainvillea* stem beetle-fed ground powder[14].

This study was designed to examine the hypoglycemic and antilipidemic effects of *Bougainvillea glabra* another *Bougainvillea* species apart from B. *spectabilis* on alloxan-induced Diabetes Mellitus based on the local uses of the plant for the treatment of diabetes mellitus.

2. Materials and Methods

2.1. Plant Material

Bougainvillea glabra leaves were collected from the University of Ilorin Botanical Garden. The leaves were removed from the stalk and air dried at room temperature ($22 \pm 1\ ^0$C) after which it was ground and sieved to fine powder and made into extracts used for the experiment. The phytochemical analyses were carried out using the method of Trease and Evans [15].

2.2 Animals

Twenty-five matured male albino rats weighing between 150-200 g were used for the experiment. Rats were housed with ad libitum access to water in a well- ventilated animal unit provided by the Department of Physiology, University of Ilorin (21 ± 5^0C, humidity 60 %, 12h light/ dark cycle). The rats were fed standard chow (Bendel Feed Ltd, Ilorin).

2.3 Experimental Design

The experiment lasted for 21 days. The experimental animals were allowed 2-week acclimatization to laboratory environment and they were subsequently divided into five groups comprising of 5 rats each. The animal groupings are as follows:

A-Normal Control: given standard rat chow and 10mL/kg of distilled,

B- Normal animals administered *Bougainvillea glabra* extract (100 mg/kg) along side the standard rat chow,

C- Diabetic rat administered alloxan according to the standard procedure [16], those that developed diabetes were afterwards given the standard rat chow for 21 days,

D-The animals were made diabetic and administered the plant extract (100 mg/kg)

E- The animals were made diabetic and administered the plant extract (400 mg/kg)

Alloxan (Sigma Aldrich, St Quentin- Fallvier, France) was injected through the penial vein at a dose of 65 mg alloxan/ kg [17] after a 24-hour fast, and confirmation of an elevated blood sugar was done 3 days later.

2.4 Biochemical Analysis

Plasma Glucose Test: Blood was collected from the tail of the rats. The blood sugar was estimated using the PRESTIGE SMART SYSTEM^{TM}, Home Diagnostics, Inc. Ft Lauderate, USA) Glucometer. The glucose estimation was made weekly throughout the study.

Lipid Profile: Blood for the determination of lipid profile was collected from the tail of the rats and measurements were carried out using an Automated Analyzer (Roche, HITACHI).

2.5 Statistical Analysis

Values were recorded as Mean ± standard error of the mean. Statistical difference between the means was determined by ANOVA followed by Duncan post Hoc test. $P< 0.05$ was accepted as significance level.

3. Results and Discussion

The phytochemical analysis of the extract reveals the presence of alkaloids, flavonoids, saponins and cardiac glycosides in *Bougainvillea glabra,* as shown in Table 1. The results of the anti-diabetic test shows that the 100 mg/kg extract of *Bougainvillea glabra* significantly ($p<0.05$) reduced the blood glucose level in the diabetic animals induced with alloxan. The 400mg/kg extract group also reduced the blood glucose level significantly ($p<0.05$). The reduction of the diabetes in the alloxan-induced animals (Group C) by the extract groups (D and E) was compared with the normal control and non- diabetic extract fed groups (A and B) respectively. It was observed that the Groups A, B, D and E had significantly reduced levels of glucose, unlike the increased glucose levels seen in the alloxan-induced animals (Group C) as shown in Table 2. The results of the lipid profile showed that the 100 mg/kg extract group of *Bougainvillea glabra* significantly ($p<0.05$) reduced the TG, LDL-C and TC, compared with the alloxan-induced diabetic group (Group C). The HDL-C which was reduced in the diabetic animals was increased in the groups administered the *Bougainvillea glabra* extract. This was also observed in the 400 mg/kg extract group. The normal control and non-diabetic-extract fed groups also had a significantly high HDL-C while the TC, TG and LDL-C were significantly reduced as shown as Figure 1.

A major serum abnormality in Diabetes Mellitus is hyperglycemia, which was induced in the diabetic rats in the present study. This is as a result of the pancreatic β cell destruction with intravenous injection of alloxan [16]. The *Bougainvillea glabra* aqueous leaf extract significantly reduced ($P<0.05$) the hyperglycemic effect of the alloxan induced diabetes in the groups treated with *Bougainvillea glabra* extract. This agrees with the local uses of the leaves of the plant for the treatment of diabetes by traditional medicine practitioners [12].

We also reported the beneficial effect of HDL-C that is referred to as the ‘good’ cholesterol, which was increased in the diabetic groups administered the *Bougainvillea glabra* extract. Major complications of Diabetes include aberrant lipid metabolism and vascular wall function. Since alterations in serum lipid profiles are known in diabetes which are likely to increase the risk of coronary heart disease, a reduction in serum lipids, particularly TC, LDL-C and TG levels should be considered as beneficial in long-term prognosis of diabetic patients. *Bougainvillea glabra* extract will thus have a potential therapeutic value in combating multifactorial atherosclerotic disorders, which are parts of the major complications of Diabetes. Reducing the risk of atherosclerosis will thus lead to the development of effective and better management of hyperlipidemia.

Bougainvillea glabra like its other species *Bougainvillea spectabilis* may contain D-pinitol (3-O-methylchiroinositol) compound, which could explain its insulin-like effects. A number of plants with potent therapeutic components like fibers, sterols, saponins, polyphenols, flavonoids etc have been investigated for their antihyperlipidemic, antioxidant and antiatheroscelorotic properties [18]. These components- alkaloids, flavonoids, saponins and cardiac glycosides were present in the *Bougainvillea glabra* plant extract. Since their potent properties can ameliorate the risk factors associated with Diabetic Mellitus, they can be said to curb the effects of Diabetes. These compounds have been reported to be beneficial with great variation in magnitude and mechanism of action [19, 20].

In conclusion, the present study has shown that the aqueous extract of the leaves of *Bougainvillea glabra* has anti-diabetic and anti-lipidemic effects. These observations also justify the traditional uses of the plant leaves for the treatment of diabetes.

Table 1. Phytochemicals Analysis of Aqueous extract of *B. glabra* leaves

Phytochemical Analysis	**Presence**
Alkaloids	+
Flavonoids	+
Cardiac glycosides	+
Saponins	+

+ indicate the presence of active compounds in the extract of *Bougainvillea glabra.*

Table 2. Weekly changes in the glucose level (mmol/L) of the rats following the administration of saline, normal diet and aqueous extract of *B. glabra*.

Groups	**PreTest**	**Week 1**	**Week 2**	**Week 3**
A	5.5±0.39	5.75±0.20	5.90±0.23	5.90±0.23
B	5.45±0.40	5.25±0.25	5.25±0.25	5.60±0.25
C	12.10±0.40	12.10±0.40	12.02±0.40	12.05±0.50
D	12.10±0.40	6.23±0.41	5.04±0.03	3.24±0.28*
E	12.10±0.40	5.23±0.50	4.74±0.41	4.04±0.03*

All values are mean ±S.E.M, n(no of rats per group)= 5 (A-Normal, B-Normal animals fed extract, C-Diabetic untreated rats, D-Diabetic rats fed 100mg/kg of extract, E-Diabetic rats fed 400mg/kg of extract), ($p< 0.05$).

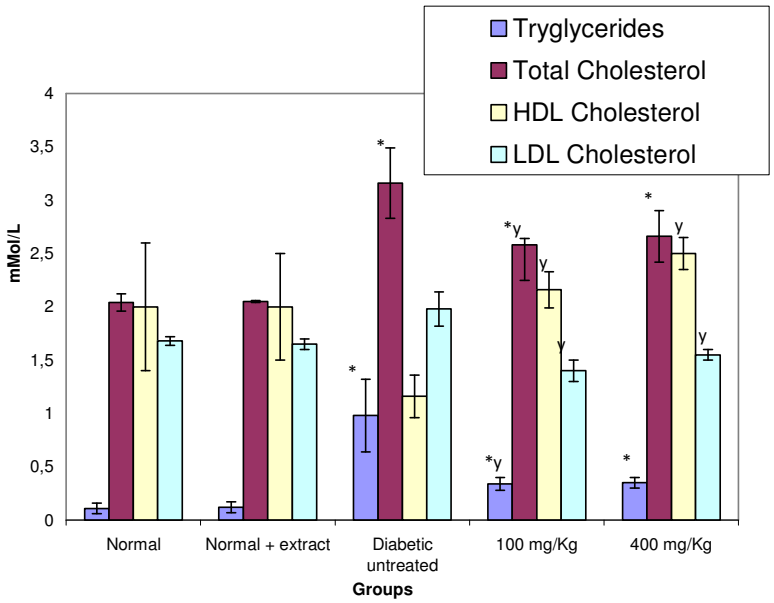

Figure 1. Plasma lipid profile in control and alloxan-induced diabetic rats and after treatment with *Bougainvillea glabra*

Acknowledgments

We are grateful to T.K. Odewo for plant identification.

References

[1] A.H. Morkadad, E.S. Ford, B.A. Bowman, D. E. Nelson, M.M. Engelgau, F. Vincor and J. S. Marks. (2000), Diabetes trends in the U.S: 1990-1998. *Diabetes Care* **23**, 1278-1283.

[2] D.M. Eisenberg, R.B. Davis, S.L. Ettner, S. Appel, S. Wilkey, M. Van Rompay and R.C Kessles (1998), Trends in alternative medicine use in the United States, 1990-1997: Result of follow-up annual survey *JAMA*. **280**, 1569-1575.

[3] V.Vuksan, J.L. Sievenpiper, Z. Xu, E.Y.Y.Wong, A.L. Jenkins, U. Beljan-Zdravkovic, L. A. Leiter, R.G. Josse and M.P. Stavro (2001), Konjac-Mannan and American Ginseng: Emerging Alternative Therapies for Type 2 Diabetes Mellitus. *J. Amer. Col. Nutr.* **20**, 370S- 380S

[4] B. Menakshi, S.S. Zinjarde, S.Y. Bhargava, A.R. Kumar, B.N. Joshi (2008). Antidiabetic Indian Plants: a Good source of potent Amylase Inhibitors. *eCAM Advance Access*. doi:10.1093/ecam/nen040

[5] N. Ali-Wali (2003). Intrapulmonary administration of natural honey solution, hyperosmolar dextrose or hyposmolar distilled water to normal individuals and to patients with type-2 diabetes mellitus or hypertension: their effects on blood glucose level, plasma insulin and C-peptide, blood pressure and peaked expiratory flow rate. *Eur J Med Res*. **31**, 295-303

[6] A.F. Fasanmade andO.T. Alabi (2008). Differential Effect of Honey on Selected Variables in Alloxan-Induced and Fructose-Induced Diabetic Rats. *Afri. J. Biomed Res*., **11**, 189-194

[7] O. Said, S. Fulder, K. Khalil, H. Azaizeh, E. Kassis and B. Saad, (2008). Maintaining a physiological blood glucose level with 'glucolevel', a combination of four anti-diabetes plants used in the traditional Arab herbal medicine. *Evid. Based Complement Alternat. Med*., **5,** 421-428

[8] R. Schoellhorn and E. Alvarez (2002). Warm climate production guidelines for Bougainvillea. Cooperative Extension Service, University of Florida, ENH874.

[9] W.C. Warren (1996). Tropical flowers of Malaysia and Singapore. Singapore: Periplus Editions HK. pp 12.

[10] Y.C. Wee (2003). Tropical trees and shrubs: A Selection for urban planting.. Singapore: Sun Tree. pp 54-55

[11] S. Yosef, L.J. Raymond.and C.M. Gunter (2001). Sand fly Feeding on Noxious Plants a Potential Method for The Control of Leishmaniasis. *Am. J. Trop. Hyg*., **65**, 300-303

[12] M.S.J. Simmonds and M.J.R. Howes (2006). Edited by Soumyanath A. Traditional Medicines for Modern Times: Antidiabetic Plants. Taylor and Francis Group, UK.

[13] E. Edwin, E. Sheeja, E. Toppo, V. Tiwari and K.R. Dutt (2007). Antidiarrheal, antiulcer and antimicrobial activities of leaves of *Bougainvillea glabra* Choisy. *Ars Pharmaceutica,* **48**, 135- 144

[14] P. Oudhia (2002-2005), Traditional Medicinal Knowledge about S*thenias griastor* Fb (Coleoptera: Cerambycidae) feeding on *Bougainvillea spectabilis* in Chattisgarh, India http://botanical.com/site/column_poudhia/poudhia_index.html (Visited on April 23, 2009)

[15] G.E. Trease and W.C. Evans (1983), A textbook of Pharmacognocy, 12th ed. Bailliere-Tindall,Ltd., London. pp 343-383

[16] T. Szkudelski, K. Kandulska and M. Okuliez (1998). Alloxan in vivo does not only exert deleterious effects on pancreatic B cells. *Physiol Res*., **47**, 343-346

[17] P.A. Gruppuso, J.M. Boylan, B.I. Posner, R. Faure, D.L. Brautigan (1990). Hepatic protein phosphotyrosine phosphatase. Dephosphorylation of insulin receptor and epidermal growth factor receptors in normal and alloxan diabetic rats. *J. Clin. Invest.,* **85**, 1754-1760

[18] N.P. Visavadiya and A.V.R.L. Narasimhacharya (2007). Asparagus root regulates cholesterol metabolism and improves antioxidant status in hypercholesteremic rats. *eCAM*: pp 1-8; doi:10.1093/ecam/nem091

[19] H.J.Jr. Harwood, C.E. Chandler, L.D. Pellarin, F.W. Bangerter, R.W. Wilkins, C.A. Long, P.G. Cosgrove, C.A. Malinow, C.A. Marzetta and J. L. Pettini (1993). Pharmacologic consequences of cholesterol absorption inhibition: alteration in cholesterol metabolism and reduction in plasma cholesterol concentration induced by the synthetic saponin β-tigogenin cellobiside (CP-88818; tiqueside). *J. Lipid Res.,* **34**, 377-395

[20] J.A. Vinson, S-J. Hu, S. Jung and A.M. Stanski (1998). A citrus extract plus ascorbic acid decreases lipids, lipid peroxidation, lipoprotein oxidation susceptibility and atherosclerosis in hypercholesterolemic hamsters. *J. Agric. Food Chem*., **46**, 1453-1459