Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 6 Issue 4 April 2022

Research Article

Glycemic and Lipidemic Effect of African Yam Bean (*Sphenostylis stenocarpa*) on Dexamethasone-Treated Pregnant Rats

Funmilola Comfort OLADELE* and Olayinka Anthony AWOYINKA

Department of Medical Biochemistry, Ekiti State University, Ado-Ekiti, Nigeria

***Corresponding Author:** Funmilola Comfort OLADELE, Department of Medical Biochemistry, Ekiti State University, Ado-Ekiti, Nigeria.

Received: February 16, 2022

Published: March 07, 2021

Abstract

This study focused on the glycemic and lipidemic effect of African yam bean (*Sphenostylis stenocarpa*) on dexamethasone-treated pregnant rats. *Sphenostylis stenocarpa* were locally sourced from a market in Ado Ekiti. They were milled into powder and used in formulating feed for experimental animals. Fifteen female pregnant rats were divided in three groups of five each. Animals in group A were exposed to standard animal feed only. This served as the control group. Those in group B were exposed to *Sphenostylis stenocarpa*-formulated diet + 0.3 mg/kg body weight of dexamethasone, while those in group C were exposed to *Sphenostylis stenocarpa*-formulated diet. At the end of eight days treatment, animals were sacrificed and blood sample was collected into EDTA bottles and centrifuged. Plasma was separated and used for the determination of glucose and lipid profile. Treatment of animals with dexamethasone was observed to significantly ($p < 0.05$) increased the concentration of plasma glucose when compared with the control as well as animals fed with *S. stenocarpa*-formulated diet only. Animals exposed to dexamethasone were observed to have higher concentrations of triglyceride, total cholesterol, low density lipoprotein (LDL) and very low-density lipoprotein (VLDL) when compared with those in animals in the control group as well as those fed with *S. stenocarpa*-formulated diet only. The results of this study showed that dexamethasone induced dyslipidemia in treated pregnant rats thus possessing the propensity to induce diabetes, obesity as well as cardiovascular diseases. *S. stenocarpa* seed on the other hand was observed to favorably regulate plasma glucose and lipid profile of pregnant rats.

Keywords: Dexamethasone; Glucose; Lipid Profile; *Sphenostylis stenocarpa*

Introduction

Coronary heart disease (CHD) or cardiovascular diseases are recognized to be one of the most important reasons of morbidity and mortality and imposes tremendously heavy socio-economic burden worldwide. There are varieties of risk factors in the literature which increases the incidence of CHD such as hyperlipidemia [1-3]. CHD occurs when cholesterol accumulates on the artery walls, creating plaques. Reduced blood flow occurs when one or more of these arteries become partially or completely blocked. The four primary coronary arteries are located on the surface of the heart are: right, left main coronary artery, left circumflex artery and left anterior descending artery [4]. CHDs are the most predictable cause of sudden death. For many years, CHD prevalence was believed to be relatively low in developed countries. Recent studies have indicated a remarkably high proportion of mild to severe CHD in a number of patients [5].

According to the guidelines of the American Heart Association, the following values are prescribed for the above-mentioned risk factors for cardiovascular disease: total cholesterol: < 200 mg/dL; triglycerides: < 200 mg/dL; HDL: > 40 mg/dL; and LDL: < 130 mg/dL [6]. The lipid profile is a group of tests that are often done together to identify the risk of heart disease. These tests are good indicators of predisposition to a heart attack or stroke caused by the blockage of blood vessels or hardening of the arteries [7].

African yam bean (AYB) *Sphenostylis stenocarpa*, Horst ex. Rich, belongs to the Fabaceae family characterized by its fruit (legume) and stipulated leaves. It originated in Ethiopia, but both wild and cultivated types now occur in tropical Africa as far north as Egypt and also throughout West Africa from Guinea to southern Africa [8]. African Yam Bean or *Sphenostylis stenocarpa* is locally known as Otili among the Yorubas. The under-exploited specie is of important food source in Africa, seeds are usually added to soups, made into sauces, or milled into flour [9,10].

Figure 1: African yam bean [11].

It grows as a vine to heights of about 3m and produces brightly colored flowers in 100 - 150 days. The yam bean is a useful source of nutrients for many African communities with a nutritional value comparable to that of the soybean, although the cooking time for the yam bean is much longer. The chemical composition of these grain legumes was shown to contain high quantities of proteins, amino acids, fiber, and minerals [12,13]. This study focused on the glycemic and lipidemic effect of African yam bean (*Sphenostylis stenocarpa*) on dexamethasone-treated pregnant rats.

Methods

Collection and preparation of materials

Dried *Sphenostylis stenocarpa* seeds were locally sourced from open bushes within Ado Ekiti, Nigeria. They were authenticated by the Chief botanist of the Department of Plant Science, Ekiti State University, Ado-Ekiti and deposited in the University's Herbarium with Voucher number UHAE-1010065. They were carefully selected to remove the perceived bad seeds. The seeds were sun-dried and milled into powder using and electric blender.

Sphenostylis stenocarpa were locally sourced from a market in Ado Ekiti. They were carefully selected to remove the perceived bad seeds. The seeds were sun-dried and milled into powder using and electric blender.

Experimental design

The use of animals for this study was approved by the Experimental Animal Research Ethics Committee of Ekiti State University, Ado-Ekiti with ethical approval number ORD/ETHICS/AD/043. Twenty-one Albino rats (6 males and 15 females) were obtained from the Animal House, Faculty of Basic Medical Sciences, College of Medicine, Ekiti State University, Ado-Ekiti. They were grouped into three of 2 males and 5 females in each group using plastic cages with steel wire lids to copulate, since the experiment requires the female Albino rats to be pregnant. They were kept at room temperature with adequate access to rat chow and water throughout the experimental period. After a week of copulation, all the female Albino rats were confirmed pregnant by the animal house technician. The males rats were removed from their cages and the female pregnant rats were treated as follows: animals in group A were exposed to standard animals feed only. This served as the control group. Those in group B were exposed to *S. stenocarpa*-formulated diet + 0.3 mg/kg body weight of dexamethasone, while those in group C were exposed to *S. stenocarpa*-formulated diet only. At the end of the eight days treatment, animals were sacrificed and blood sample was collected into EDTA bottles and centrifuged. Plasma was separated and preserved at 4 for determination of lipid profile.

Determination of biochemical parameters

Plasma glucose concentration was determined according to the methods of described by Barham and Trinder [14] (Dialab, Austria) while lipids were extracted and determined according to the methods previously described by Owoade., *et al*. [15,16].

Statistical analysis

Data were subjected to analysis of variance using Graph Pad Prism. Results were presented as Mean ± Standard deviation. One way analysis of variance (ANOVA) was used for comparison of the means followed by Tukey's post hoc test. Differences between means were considered to be significant at p < 0.05.

Results

Treatment of animals with dexamethasone was observed to significantly (p < 0.05) increased the concentration of plasma glucose when compared with the control as well as animals fed with *S. stenocarpa*-formulated diet only (Figure 2). Animals exposed to dexamethasone were observed to have higher concentrations of triglyceride, total cholesterol, low density lipoprotein (LDL) and very low density lipoprotein (VLDL) when compared with those in animals in the control group as well as those fed with *S. stenocarpa*-formulated diet only as presented in figures 3-8.

Figure 2: Effect of *S. stenocarpa*-formulated diet on the Concentration of Plasma Glucose of Dexamethasone-Treated Pregnant Rats.

Results are presented as mean ± standard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Figure 3: Effect of *S. stenocarpa*-formulated diet on the Concentration of Plasma Triglyceride of Dexamethasone-Treated Pregnant Rats.

Results are presented as mea ± nstandard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Figure 4: Effect of *S. stenocarpa*-formulated diet on the Concentration of Plasma Total Cholesterol of Dexamethasone-Treated Pregnant Rats.

Results are presented as mean ± standard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Figure 5: Effect of *S. stenocarpa*-formulated diet on the Concentration of Plasma High Density Lipoprotein (HDL)-Cholesterol of Dexamethasone-Treated Pregnant Rats.

Results are presented as mean ± standard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Figure 6: Effect of *S. stenocarpa*-formulated diet on the Concentration of Plasma Low Density Lipoprotein (LDL)-Cholesterol of Dexamethasone-Treated Pregnant Rats.

Results are presented as mean ± standard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Figure 7: Effect of *S. stenocarpa*-formulated diet on the Concentration of HDL/LDL Ratio of Dexamethasone-Treated Pregnant Rats.

Results are presented as mean ± standard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Figure 8: Effect of *S. stenocarpa*-formulated diet on the Concentration of Plasma Very Low Density Lipoprotein (VLDL)-Cholesterol of Dexamethasone-Treated Pregnant Rats.

Results are presented as mean ± standard deviation with n = 5. Bars with different letters are significantly different at P < 0.05.

Discussion

The prevalence of diabetes and cardiovascular diseases is on the increase even during pregnancy. The treatment of ailment during pregnancy is peculiar owing to the effect of drugs on the fetus. Recently, the use of herbal remedy has gained popularity due to its perceived minimal side effect compared to orthodox drugs. This present study tends to evaluate the effect of *S. stenocarpa* seeds on the blood glucose and lipid profile of pregnant Wistar rats.

The results of this study showed that dexamethasone administration significantly ($p < 0.05$) increased the concentration of plasma glucose in treated animals when compared with those in the control group. This result is in agreement with the findings of Oladele., *et al*. [17] who recently reported that dexamethasone increased the plasma concentration of glucose in pregnant rats. The result also corresponds with the observations of Niu., *et al*. [18] who treated goats with dexamethasone. It is also in line with the report of Hans., *et al*. [19] who studied the blood glucose concentration profile after 10 mg dexamethasone in non-diabetic and type 2 diabetic patients undergoing abdominal surgery. In an earlier report, Chap., *et al*. [20], observed that dexamethasone significantly increased glucose concentrations in conscious dogs. Bernal-Mizrachi., *et al*. [21], had previously reported that dexamethasone induced diabetes, thus confirming its hyperglycemic effect observed in this study. However, exposing animals to *S. stenocarpa*-formulated diet only was observed to lower plasma glucose when compared with those in the group exposed to dexamethasone. The glucose-lowering potential of *S. stenocarpa* observed in this preset study collaborated the findings of Nwankwo., *et al*. [22] who reported that *S. stenocarpa* seed is used as an alternative medicine to control diabetes mellitus in streptozocin-induced rats.

Different plant extracts have also been used as antihyperglycemic as well as insulin-stimulatory agents [23-26]. Most of these plants have been reported to contain phytochemicals such as glycosides, alkaloid and flavonoids [27-29]. Phytochemical analysis of *S. stenocarpa* has revealed that that they contain cardiac glycosides and alkaloids [22]. These phytochemicals may then be responsible for the hypoglycemic effect of *S. stenocarpa*. The plasma glucose reducing effect of *S. stenocarpa* could also an indication that it possesses antidiabetic properties which could control hyperglycemia. In fact, a previous study by Nwankwo., *et al*. [30] highlighted the anti-diabetic activity of *S. stenocarpa* seed extract in alloxan-induced diabetic rats.

The analysis of lipid profile in this study revealed that exposure of animals to dexamethasone led to a significant ($p < 0.05$) increase in the concentrations of lipids (except HDL) when compared with those in animals in the control group as well as animals fed with *S. stenocarpa*–formulated diet only. Dexamethasone has been reported to induce diabetes and dyslipidemia [21]. It has also been reported to induce hypertension [31]. The result of this study is in agreement with that of Krupková., *et al*. [32] as well as that of Kamel., *et al*. [33]. Dexamethasone belongs to the group of synthetic corticosteroids that has important anti-inflammatory and anti-allergic influences and results in the pain of inflammatory processes, especially in joints. Also, dexamethasone outcomes in the destruction of the immune method, and these effects can often influence different systems of the body [34]. Delaying the healing of wounds, affliction with diabetes, the effect on the balance of body fluids and electrolytes that results in retention of salt and water in the body, the effect on the distribution of lipids in the body and consequently the quantity of lipids in specific sections of the body such as back of the neck, increase of hypertension, blood sugar and excessive hairs in different parts of the body such as face, especially in females, being among the other adverse effects of inappropriate and excessive use of this ampule [35]. The effect of dexamethasone on the lipid profile of female pregnant rats used in this study also corresponds to the findings of Arab and Mahboubi [34], who exposed adult male rats to dexamethasone. It also collaborated the findings of Oladele., *et al*. [17] who reported hyperlipidemia in pregnant female rats exposed to dexamethasone.

The results of this study showed that animals fed with *S. stenocarpa*–formulated diet only had significantly lower lipid concentrations (except HDL which is higher) when compared with those in animals in the exposed to dexamethasone (figures 3-8). The lipid-lowering effect of *S. stenocarpa* seed on female pregnant rats used in this study is similar to the study of Ogbu., *et al*. [36] who reported that *S. stenocarpa* seed extract attenuates dyslipidemia in testosterone propionate-induced benign prostatic hyperplasia in rats. This might be an indication that *S. stenocarpa* seed may prevent the progression of cardiovascular diseases. In fact, Awoyinka., *et al*. [37] reported that *S. stenocarpa* supplementation prevents high fat diet induced derangements in kidney of albino rats.

Conclusion

The results of this study showed that dexamethasone induced dyslipidemia in treated pregnant rats thus possessing the propensity to induce diabetes, obesity as well as cardiovascular diseases. *S. stenocarpa* seed on the other hand was observed to favorably regulate plasma glucose and lipid profile of pregnant rats.

Consent

It is not applicable.

Conflict of Interests

Authors have declared that no conflict of interests exist in this study and publication.

Bibliography

1. Airaodion AI., *et al*. "Hypolipidaemic and antidiabetic potency of Allium cepa (onions) bulb in alloxan-induced diabetic rats". *Acta Scientific Nutritional Health* 4.3 (2020): 1-8.
2. Njoku OC., *et al*. "Antidiabetic potential of alkaloid extracts from *Vitex doniana* and *Ficus thonningii* leaves on alloxan-induced diabetic rats". *International Research Journal of Gastroenterology and Hepatology* 2.2 1-12.
3. Airaodion AI., *et al*. "Pharmacotherapeutic effect of methanolic extract of *Telfairia occidentalis* leaves on glycemic and lipidemic indexes of alloxan-induced diabetic rats". *International Journal of Bioscience and Biotechnology* 11.8 (2019): 1-17.
4. Saumya Gupta., *et al*. "A study of risk factors in young patients of acute coronary syndrome". *International Journal of Contemporary Medical Research* 4 (2017): 2144-2147.
5. John VC., *et al*. "Valvular heart disease. In: The Johns Hopkins manual of cardiac surgical care". 2nd edition. Marry land, Baltimore, Elsevier publisher (2007): 96.
6. Bonow RO., *et al*. "Guidelines for the management of patients with valvular heart disease: a report of the American Heart Association Task Force on Practice Guidelines". *Circulation* 114 (2006): 84-231.
7. Vuyisile TN., *et al*. "Burden of valvular heart diseases: a population-based study". *The lancet* 368 (2006): 969-971.
8. Busson F. "Root crop" (2021).
9. Amoatey HM., *et al*. "The African Yam Bean (*Sphenostylis stenocarpa*): A Neglected crop in Ghana". *West African Journal of Applied Ecology* 1 (2000): 53-60.
10. Adeyeye EI and Agesin OO. "Dehulling the African Yam Bean (Sphenostylis stenocarpa Hochst. ex A. ich) Seeds: Any Nutritional Importance?" *Bangladesh Journal of Scientific and Industrial Research* 42.2 (2007): 163-174.
11. Klu GYP., *et al*. "Cultivation and use of African yam bean (Sphenostylis stenocarpa) in the Volta region of Ghana". *The Journal of food Technology* 6.3 (2001): 74-77.
12. Arinathan V., *et al*. "Chemical composition of certain tribal pulses in South India". *International Journal of Food Sciences and Nutrition* 54 (2003): 209-217.
13. Campos-Vega R., *et al*. "Chemical composition and *in vitro* polysaccharide fermentation of different beans (Phaseolus vulgaris L.)". *Journal of Food Science* 74 (2019): 59-65.
14. Barham D and Trinder P. "An improved colour reagent for the determination of blood glucose by the oxidase system". *The Analyst* 97.1151 (1972): 142.
15. Owoade AO., *et al*. "Toxicological assessment of the methanolic leaf extract of *Bridelia ferrugelia". The Journal of Phytopharmacology* 7.5 (2018): 419-424.
16. Owoade AO., *et al*. "Levofloxacin-induced dyslipidemia in male albino rats". *Asian Journal of Pharmacy and Pharmacology* 4.5 (2018): 620-629.
17. Oladele FC., *et al*. "Effect of *Parkia biglobosa* Seed on Lipid Profile of Dexamethasone-Treated Pregnant Rats". *World Journal of Biology Pharmacy and Health Sciences* 08.03 (2021): 30-39.
18. Niu L., *et al*. "Effects of chronic dexamethasone administration on hyperglycemia and insulin release in goats". *Journal of Animal Science and Biotechnology* 9.26 (2018): 1-10.
19. Hans P., *et al*. "Blood glucose concentration profile after 10 mg dexamethasone in non-diabetic and type 2 diabetic patients undergoing abdominal surgery". *British Journal of Anaesthesia* (2006): 1-7.
20. Chap Z., *et al*. "Effect of dexamethasone on hepatic glucose and insulin metabolism after oral glucose in conscious dogs". *Journal of Clinical Investigation* 78.5 (1986): 1355-1361.

21. Bernal-Mizrachi C., *et al*. "Dexamethasone induction of hypertension and diabetes is PPAR-alpha dependent in LDL receptor-null mice". *Nature Medicine* 9 (2003): 1069-1075.

22. Nwankwo MO., *et al*. "Ethnopharmacological Use of Sphenostylis stenocarpa (Hochst ex.A. Rich.) Harms Seed Milk As Alternative Medicine to Control Diabetes Mellitus In Streptozocin-Induced Rats". *Journal of Research in Pharmaceutical Science* 7.7 (2021): 05-13.

23. Airaodion AI., *et al*. "Antidiabetic effect of ethanolic extract of *Carica papaya* leaves in alloxan-induced diabetic rats". *American Journal of Biomedical Science and Research* 5.3 (2019): 227-234.

24. Airaodion AI., *et al*. "Effect of oral intake of African locust bean on fasting blood sugar and lipid profile of albino rats". *Asian Journal of Research in Biochemistry* 4.4 (2019): 1-9.

25. Airaodion AI and Ogbuagu EO. "Effect of consumption of garri processed by traditional and instant mechanical methods on lipid profile of Wistar rats". *Asian Journal of Research and Reports in Gastroenterology* 3.1 (2020): 26-33.

26. Ogbuagu EO., *et al*. "Effect of methanolic extract of *Vernonia amygdalina* leaves on glycemic and lipidaemic indexes of Wistar rats". *Asian Journal of Research in Medical and Pharmaceutical Sciences* 7.3 (2019): 1-14.

27. Airaodion AI., *et al*. "Comparative assessment of phytochemical content and antioxidant potential of *Azadirachta indica* and *Parquetina nigrescens* leaves". *Asian Plant Research Journal* 2.3 (2019): 1-14.

28. Airaodion AI., *et al*. "Evaluation of Phytochemical Content and Antioxidant Potential of *Ocimum gratissimum* and *T. occidentalis* leaves". *Asian Journal of Research in Medical and Pharmaceutical Sciences* 7.1 (2019): 1-11.

29. Airaodion AI., *et al*. "Hypoglycemic and hypolipidaemic activities of methanolic extract of *Talinum triangulare* leaves in Wistar rats". *International Journal of Bioscience and Biotechnology* 11.5 (2019): 1-13.

30. Nwankwo MO., *et al*. "Investigation on the Anti-diabetic Activity of *Sphenostylis stenocarpa* Seed Milk Extract in Alloxan-induced Diabetes Rats". *International Journal of Scientific and Research Publications* 8.8 (2018): 824-829.

31. Brotman DJ., *et al*. "Effects of short-term glucocorticoids on cardiovascular biomarkers". *The Journal of Clinical Endocrinology and Metabolism* 90.6 (2005): 3202-3208.

32. Krupková M., *et al*. "Pharmacogenetic interaction between dexamethasone and *Cd36*-deficient segment of spontaneously hypertensive rat chromosome 4 affects triacylglycerol and cholesterol distribution into lipoprotein fractions". *Lipids in Health and Disease* 9.38 (2010): 1-7.

33. Kamel AM., *et al*. "Lipid profile of Hyperlipidemic mice induced by dexamethasone treated with 105 herbals oil mixture". *Diyala Journal of Medicine* 11.1 (2016): 24-31.

34. Arab DA and Mahboubi M. "A study of the influence of dexamethasone on lipid profile and enzyme lactate dehydrogenase". *Journal of Medicine and Life* 8.3 (2015): 72-76.

35. Xue Q and Patterson AJ. "Glucocorticoid Modulates Angiotensin II Receptor Expression Patterns and Protects the Heart from Ischemia and Reperfusion Injury". *PloS One* 9.9 (2014): e106827.

36. Ogbu PN., *et al*. "*Sphenostylis stenocarpa* Seed Extract Attenuates Dyslipidemia in Testosterone Propionate-induced Benign Prostatic Hyperplasia in Rats". *Pakistan Journal of Biological Sciences* 24 (2021): 151-157.

37. Awoyinka OA., *et al*. "*Sphenostylis stenocarpa* (Hochst. Ex A. Rich) and fermented *Parkia biglobosa* (Jacq, R.B.R.) supplementation prevents high fat diet induced derangements in kidney of albino rats". *African Journal of Biochemistry Research* 15.1 (2021): 1-8.