Journal of Advances in Medicine and Medical Research

34(6): 78-83, 2022; Article no.JAMMR.84590
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Evaluation of Hypoglycaemic, Antihyperglycaemic and Anti-lipid Peroxidative Activity of *Persea americana* Peel in Wistar Rats

O. N. Ilochi [a*], T. A. Kolawole [b] and A. N. Chuemere [a,c,d]

[a] Department of Human Physiology, Faculty of Basic Medical Sciences, Madonna University, Elele, Rivers State, Nigeria.
[b] Department of Human Physiology, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria.
[c] Department of Human Physiology, Faculty of Basic Medical Sciences, University of Port Harcourt, Choba, Rivers State, Nigeria.
[d] Department of Nursing, Faculty of Basic Medical Sciences, Clifford University, Owerrinta, Abia State, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2022/v34i631316

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/84590

Original Research Article

Received 09 January 2022
Accepted 13 March 2022
Published 04 April 2022

ABSTRACT

This study evaluated the hypoglycaemic, antihyperglycaemic and anti-lipid peroxidative activity of Persea americana peel in experimental rats. 60 male wistar rats were used for this study which lasted for 42 days. The animals were randomly grouped as: A-Normal control (feed + distilled water), B- Glibenclamide 0.6mg/kg/day, C- Avocado peel extract 50mg/kg, D- Diabetic, E- Diabetic + glibenclamide 0.6mg/kg/day, F- Diabetic + avocado peel extract 50mg/kg. Fasting blood glucose and blood level of glycated hemoglobin (HbA1C) were assayed for. With standard protocols, the heart and kidney of each animal was collected for tissue homogenization. Biochemical analysis of tissue homogenates includes Thiobarbituric acid reactive substances (TBARS) and isoprostanes (F2isoP). This study revealed a possible link between oxidative stress and hyperglycaemia in diabetic conditions. Avocado peel, dose and time-dependently reduced blood glucose level below normal as well as products of lipid peroxidation.

**Corresponding author: E-mail: ilochiogadinma@gmail.com;*

Determination of the possible mechanisms by which avocado peel affects these biomarkers may be indispensible to medicinal research. This study revealed further therapeutic potential of avocado peel.

Keywords: Diabetic; persea americana; endemic; peel; analysis.

1. INTRODUCTION

Diabetes is an endemic disease that stands as a threat to human existence [1]. Diabetes is a disease characterized by defective metabolism of all food types due to lack of insulin or as a result of insulin insensitivity [2]. Hyperglycemia, which is an abnormal persistent increase in blood glucose [3], is a useful diagnosis of this disease. The alarming number of death cases related to diabetes has made this disease a global concern. According to a report by the world health organization (WHO) in 2017, 422 million people would live with the diabetes in the world [1]. Prevalence of the diabetes almost doubled since 1980, increasing from 4.7 % to 8.5 % in 2014 and this prevalence increased more in countries with low or intermediate incomes [2]. In Africa, prevalence of diabetes increased from 3.1 % to 7.1 % between 1980 and 2014 [2,4].

Type 2 diabetes, also known as non-insulin dependent type, is the most common form and progresses with sociocultural changes; we consider that 91 % of adults affected by the disease have type 2 diabetes [4]. Type 1 diabetes is less common and usually inherited or related to autoimmunity and viral infections [4,5]. The complications of diabetes are a major causeof mortalityin most of countries. Some studies have postulated a mechanism relating diabetes to oxidative stress and subsequent lipid peroxidation. An approach to management of diabetes may as well be aimed at preventing free radical damage.Hyperglycemia may be the cause of increased productsof lipid peroxidation diagnosed in diabetics. In 2012, about 3.7 million deaths were bound to abnormal blood glucose level [6]. As a possible solution to this problem, hygieno-dietary measures should be employed, the injection of synthetic anti-diabetic hormone insulin as well as the treatment by oral anti-diabetics; this may have consequences because of their high cost and adverse effects. Due to the fact that treatments by use of conventional medicines remains expensive and sometimes not accessible, and the unwanted effects of such treatment remains a burden, an alternative or complementary medicine is obviously indispensible, in particular the treatments with medicinal plants [7]. According to the WHO, 80 % of African population resort to traditional medicine for primary health needs [8]. With constant increase in use of plants as medicines and the fast expansion of the world market, the safety and the quality of plant materials and the finished products from plants have become a major concern for various health authorities, pharmaceutical industries and the public. The development of therapeutic agents using traditional techniques and philosophy as well as the improved traditional methods of treatment, occupies an important place in research institutes in Africa.

Avocado (*Persea americana*) fruit has great nutritional importance as a source of protein, carbohydrate and fiber [9]. It contains essentialmicronutrients for human consumption such asvitamins, minerals, and polyphenols [9,10]. There is a scarcity of knowledge about fruit and vegetable nutrients, as well as their peels and stems,generating waste in tons that could be used as food.The same is true for avocado, because tons of thisfruit are discarded in Africa. The oil of an avocado has medicinal propertiesand its peel contains significant amounts of minerals in addition to compounds that prevent lipid oxidation [9,10,11]. The leaves and peels could also be consumed as medicinal food.

Despite the advent of orthodox medicines, there is still a steady rise in occurrence of metabolic diseases. There is an urgent need to develop alternative form of treatments to combat this adversity.

The present study aimed at evaluating the hypoglycaemic and antihyperglycaemic impact of avocado peel hydroethanolic extract in an experimental design which samples diabetic and non-diabetic wistar rats.

2. MATERIALS AND METHODS

2.1 Plant Material

In November 2020, avocado peel was collected from fruits purchased in fruit garden in Port Harcourt.

Chart 1. Study design

Groups	Treatments
A	Normal control (feed + distilled water)
B	Glibenclamide 0.6mg/kg/day
C	Avocado peel extract 50mg/kg
D	Diabetic
E	Diabetic + glibenclamide 0.6mg/kg/day
F	Diabetic + avocado peel extract 50mg/kg
	N=5

The study duration was 42 days after 14 days period of acclimatization.

2.2 Animal Collection

60 male wistar rats were used for this study. Top feed® was provided *Ad libitum*.

2.3 Biochemical Procedures

2.3.1 Extract preparation

Hydroethanolic extract (water and ethanol *v/v* 1:4) was prepared following procedures previously described [12].

2.3.2 Induction of diabetes in rats

Five adult wistar rats weighing 250-300 grams (75-90 days old) were used. The animals were injected streptozotocin, (SIGMA S0130-1G) intravenously at a dose of 60 mg/kg of body weight. Streptozotocin induces diabetes within 3 days by destroying the beta cells. Diabetic animals and non-diabetic controlgroups were kept in metabolic cages individually and separately, under feeding and metabolic control. Glucose in theblood of diabetic rats (≥12.0mmol/l) exceeded that of the non-diabetic control (≤4.2mmol/l). Food consumption was measured in grams, waterconsumption and urine volumewas measured in ml on a daily basis while every 2-4 weeks in 80 days the levels of C-peptide, insulin and glucosein blood serum were also measured, so that chemical diabeteswas verified in rats injected with streptozotocin.

2.3.3 Sacrifice and sample collection

Few hours after treatment on day 42, the animals were anaesthetized with diethyl-ether and sacrificed. 5 ml of blood was collected from each animal via left ventricular puncture. The pancreas was obtained and rinsed in ice cold solution for tissue homogenization. The samples were analyzed in chemical pathology laboratory, Madonna University, Nigeria.

Other biochemical analysis carried out include; fasting blood glucose (FBG), test for glycated hemoglobin (HbA1c) and lipid peroxidation production malondialdehyde (MDA) and isoprostanes (F_2isoP). These tests were carried out following procedures previously described[13].

2.3.4 Statistical analysis

IBM®SPSS version 20.0 was the statistical tool used for this study. Data was expressed as Mean ± standard error of mean (SEM). One way analyses of variance (ANOVA) as well as Percentage change *(%c*) were calculated using recommended biostatistical guidelines.

3. RESULTS

The following results were obtained from this study;

Blood glucose-regulating activity of avocado peel extracts; from Table 1, there was a time-dependent decrease in blood glucose in groups B, C, E and F. The decrease in blood glucose caused by glibenclamide was similar to the decrease caused by avocado peel extract. The percentage change *(%c*) from day 0 to day 42 for group B treated glibenclamide was -34.5; while the percentage change from same period for group C was -32.7. The extract caused an almost similar blood glucose-regulating activity as an antidiabetic drug.

From Table 2; just like the effect of the extract on blood glucose, there was a similar activity on glycated hemoglobin. The extract significantly reduced blood glucose from day 21 to day 0 at a percentage change of -37.1, and from day 42 to day 0 at a percentage change of -40.3. Also, as there is a time-dependent reduction in the level of glycated hemoglobin in both groups E and F, it can be said that the extract has similar antihyperglycaemic effect as glibenclamide.

Table 1. Effect of treatments on fasting blood glucose

Groups	Blood glucose (mmol/l)						
	Days						
	0	0→21	21	21→42	42	0→42 %	overall
A	4.14±0.14	0.9	4.18±0.91	-1.19	4.13±0.14	-0.24	0.95
B	4.17±0.12	-9.5	3.77±0.410	-27.5	2.73±0.230,21	-34.5	-7
C	4.22±0.11	-10.1	3.79±0.240	-25.0	2.84±0.170,21	-32.7	-7.7
D	16.20±0.14	13.0	18.31±0.470	26.3	23.14±0.010,21	42.8	16.5
E	13.41±0.81	-28.1	9.63±0.020	-24.9	7.23±0.120,21	-46.0	-55.6
F	12.70±0.03	-23.0	9.77±0.130	-24.0	7.42±0.240,21	-41.5	-17.5

Key; 0= significantly different compared to day 0, 21= significantly different compared to day 21.

Table 2. Effect of treatments on glycated hemoglobin

Groups	HbA1c (%)						
	Days						
	0	0→21	21	21→42	42	0→42 %	Overall
A	3.81±1.14	-10.2	3.42±0.41	9.0	3.73±0.32	-0.02	-9.0
B	3.90±0.30	-42.8	2.23±0.120	-1.34	2.20±2.00	-43.5	-42.16
C	3.72±0.10	-37.0	2.34±0.420	-5.12	2.22±1.210	-40.3	-35.18
D	6.82±0.02	0.87	6.88±0.11	4.7	7.21±0.410,21	5.71	1.0
E	6.88±1.12	-24.2	5.21±2.10	-9.21	4.73±0.420,21	-31.2	-22.9
F	7.0±1.2	-23.7	5.34±0.310	-10.1	4.80±0.030,21	-31.4	-21.3

Key; 0= significantly different compared to day 0, 21= significantly different compared to day 21.

Table 3. Effect of treatments on secondary products of lipid peroxidation

Groups	Lipid peroxides (µg/ml)					
	MDA	*%c→A*	*%c→B*	F_2isoP	*%c→A*	*%c→B*
A	90.6±0.12	-	125.3	40.1±0.41	-	72.8
B	40.2±2.12A	-55.6	-	23.2±1.12A	-42.1	-
C	51.2±1.41A	-43.4	27.3	32.3±1.32A	-19.4	39.2
D	123.2±1.32A	35.9	206.4	78.1±1.21A	94.7	236.6
E	60.3±0.02A	-33.4	50	43.1±1.31A	7.4	85.7
F	67.2±0.41A	-25.8	67.1	41.4±1.21	3.2	78.4

Key; A= significantly different compared to control (A), %c→A= Percentage change relative to group A (control), %c→B=Percentage change relative to group B (Gliblenclamide).

From Table 3, avocado peel extract significantly reduced pancreatic tissue level of MDA and F2isoP. This means that the extract may have improved glucose tolerance by regulating free radical induced pancreatic cell membrane lipid peroxidation. Glibenclamide-treated groups also showed similar results. This may be another possible mechanism needed to ensure glucose hemostasis. For MDA, the extact alone caused a percentage change of -43.5 compared to control, while for F2isoP, the extract caused a percentage change of -19.5.

4. DISCUSSION

Similar to the effect of glibenclamide, avocado peel extract significantly reduced blood glucose level. From the results, if the treatment period was prolonged, both the drug and extract may cause hypoglycemia. The mechanism by which the extract caused a decrease in blood glucose may be related to insulin synthesis, release, sensitivity and degradation. The diabetic group treated with the extract also revealed progressive decrease in blood glucose. Some phytochemicals present in avocado peel extract have already been revealed [14]. Any effect the extract has on a physiologic response depends on specific phytochemicals it contains. Flavonoids, before now, have been known to reduce blood glucose as well as percentage of glycated hemoglobin [14,15]. Other phytochemicals like alkaloids have also shown remarkable positive effect on blood glucose [15]. The extract may probably possess the inherent ability to mop up free radical species which may

be its indirect pathway of regulating blood glucose level. This study may have postulated a possible inverse relationship between oxidative stress and hypoglycemia. As seen in the result, blood glucose level was increased significantly, progressively and persistently in groups that had increased levels of products of lipid peroxidation. What this may infer is that, there is a possible link between diabetes and oxidative stress. This has been stated in several studies [16,17,18]. Oxidative modification of insulin receptors or signaling proteins may be another suspected cause of the difference in blood glucose level in the test groups. This study, for the time period it lasted, is good evidence that avocado peel extract may have significant anti-hyperglycaemic ability, but if the time period is prolonged, then its hypoglycaemic activity may be appreciated.

5. CONCLUSION

From the outcome of this study, avocado peel extract may be an effective anti-hyperglycaemic and hypoglycaemic agent. It may directly influence overall insulin activity or prevent oxidative modification of cellular mechanisms involved in blood glucose regulation.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

This study was approved by the Madonna University Research Ethics Committee, MUREC/PHYS/245. This study was in strict adherence to standard protocols regarding the use of animals in research [12].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of Diabetes: Estimates for the year 2000 andprojections for 2030. Diabetes Care. 2004;27:1047-1053.
2. Motala AA. Diabetes Trends in African.Diabetes metabRes Rev. 2002;18:514-520.
3. Lifestyles statistics team, Health and Social Care Information Centre. Statistics on Obesity, Physical Activity and Diet: England;2014.
   Available:www.hscic.gov.uk
4. Nwafor A, Owhoji A. Prevalence of diabetes mellitusamong Nigerians in Port Harcourt correlates witheconomic status. J. Appl. Sci. Environ. Mgt. 2001;5:75-77.
5. Nyenwe EA,Odia OJ, Ihekwaba AE, Ojule A, Babatunde S. Type 2 Diabetes in adult Nigerians: A studyof its prevalence and risk factors in Port Harcourt,Nigeria. Diabetes Res Clin Pract. 2003;62:177-185.
6. Nwafor A, Mmom FC, Obia O, Obiandu C, Hart VO and Chinko BC.Relationship between blood pressure, blood glucose and body mass index and coexisting prehypertension and prediabetes among rural adults in Niger Delta Region, Nigeria. British Journal of Medicine & Medical Research. 2015;9(7):1-12.
7. Ilochi Ogadinma, Kolawole Tolunigba Abisola, Arthur Nwafor Chuemere, Bassey Samuel, Paul Moundipa. Hepatorenoprotective Potential of *Cocosnucifera* (coconut) Juice in Normal Male Humans. Saudi Journal of Medical and Pharmaceutical Sciences.
   DOI: 10.21276/sjmps.2018.4.12.4
8. Unachukwu CN, Uchenna DI, Young EE. Mortality among Diabetes in-patients in Port Harcourt Nigeria.African Journal of Endocrinology and Metabolism. 2008;7:1-4.
9. Ilochi ON, Chuemere AN, Olorunfemi OJ Amah-Tariah FS. Evaluation of Pharmacognostic, Nutraceutic and Phytotherapeutic Constituents of Unripe *Musa sapientum* Hydromethanolic Extracts. J Phytopharmacol. 2021;10(3):156-161.
10. Ogadinma Ilochi, Arthur Nwafor Chuemere. Neuroprotective Potential of Avocado Peel Correlates with Antioxidant Status in Starvation and Refeeding in Wistar Rats. World Wide Journal of

Multidisciplinary Research and Development WWJMRD. 2019;5(1):70-74. Impact Factor MJIF: 4.25 E-ISSN: 2454-6615.(2019).

11. Dreher ML, Davenport AJ. Hass Avocado composition and potential oil health effects, Crit Rev Food SciNutr. 2013;53:738-750.
12. Hurtado-FernaÂndez E, Carrasco-Pancorbo A, FernaÂndez-GutieÂrrez A. Profiling LC-DAD-ESI-TOF MS method for the determination of phenolic metabolites from avocado (Perseaamericana). J Agric FoodChem. 2011;59:2255±2267.
13. Ilochi Ogadinma, Arthur Nwafor Chuemere, EkwemIkechukwu, Bassey Samuel Neuroprotective and Antitoxic Potential of Hydromethanolic Extract of *Allium cepa* in Experimental Rats. European Journal of Pharmaceutical and Medical Research.Ejpmr. 2018; 5(9):138-143, ISSN 2394-3211 EJPMR.
14. Brunetti C, Di Ferdinando M, Fini A, Pollastri S, Tattini M. Flavonoids as antioxidants and developmental regulators:relative significance in plants and humans.Intern J Mol Sci. 2013;14:3540-55.
15. Tsoi B, Yi RN, Cao LF, Li SB, Tan RR, Chen M, Li XX, Wang C, Li YF, KuriharaH, He RR. Comparing antioxidant capacityof purine alkaloids: A new, efficient trio forscreening and discovering potentialantioxidants in vitro and in vivo. FoodChem. 2015;176:411-9.
16. Shabbir M, Khan MR, Saeed N. Assessment of phytochemicals, antioxidant,anti-lipid peroxidation and antihemolyticactivity of extract and various fractions of *Maytenusroyleanus*leaves.BMC Compl Altern Med. 2013;13:143.
17. Ceriello, A. and E. Motz (2004). Is oxidative stress the pathogenic mechanism underlying insulin resistance, diabetes, and cardiovascular disease? The common soilhypothesis revisited *Arteriosclerosis, Thrombosis, and Vascular Biology* 24: 816-823.
18. Martin-Gallan P, Carrascosa A, et al. Biomarkers of diabetes-associated oxidative stress and antioxidant status in young diabetic patients with or without subclinicalcomplications. Free Radical Biology and Medicine. 2003;34(12):1563-1574.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/84590