Journal of Advances in Medical and Pharmaceutical Sciences
7(3): 1-6, 2016, Article no.JAMPS.25500
ISSN: 2394-1111

SCIENCEDOMAIN *international*
www.sciencedomain.org

Effect of Aqueous Stem Bark Extract of *Khaya senegalensis* (ASBEKS) on Lipid Profile in Diet Induced Hyperlipidemic Rats

I. U. Muhammad[1*] and A. J. Alhassan[1]

[1]Department of Biochemistry, Faculty of Basic Science, Bayero University, P.M.B. 3011, Kano, Nigeria.

Authors' contributions

This work was carried out in collaboration among both authors. Authors IUM and AJA designed the study and wrote the protocol. Author IUM managed the animals, collected all data, performed the statistical analysis and wrote the first draft of the manuscript. Author AJA did the literature search and also wrote part of the manuscript. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMPS/2016/25500
Editor(s):
(1) Palmiro Poltronieri, National Research Council of Italy, CNR-ISPA, Italy and Institute of Sciences of Food Productions, Operative Unit in Lecce, Italy.
Reviewers:
(1) Dinithi Peiris, University of Sri Jayewardenepura, Sri Lanka.
(2) Neamat Hanafi Ahmed Osman, National Centre for Radiation Research and Technology, Cairo, Egypt.
(3) Parineeta Samant, MGM Medical College, Navi-Mumbai, India.
Complete Peer review History: http://sciencedomain.org/review-history/14176

Original Research Article

Received 6th March 2016
Accepted 6th April 2016
Published 14th April 2016

ABSTRACT

In this study, aqueous stem bark extract of *Khaya senegalensis* (ASBEKS) was administered to hyperlipidemic rats to evaluate its effects on lipid parameters. Fifty (50) albino rats were divided into five groups (I, II, III, IV and V) of ten rats each. Group I served as normal control. Group II served as hyperlipidemic control group, Group III, IV and V were hyperlipidemic and administered with the extract at a dose of 100 mg/kg, 200 mg/kg and 300 mg/kg per day respectively for two weeks. At the end of the first week, five rats were selected randomly from each group, euthanized and serum was collected for analysis of lipid profile (Total Cholesterol, LDL-Cholesterol, HDL-Cholesterol and Triglyceride). The remaining rats were euthanized for analysis of serum lipid profile at end of the second week. A significant decrease ($p<0.05$) was observed in the mean serum Total Cholesterol, LDL-Cholesterol and Triglyceride in test groups (Groups III, IV and V) animals administered with the

**Corresponding author: E-mail: ibrahimmuhd@yahoo.com;*

extract for two weeks when compared with the hyperlipidemic control (Group I). A significant increase ($p>0.05$) in HDL-Cholesterol was only observed in group V administered with the highest dose of the extract for two weeks. The observed anti hyperlipidemic activity of extract support the traditional claim and could be associated with its phytochemicals contents.

Keywords: High fats diets; hyperlipidemic rats; lipid profile; Khaya senegalensis.

1. INTRODUCTION

Hyperlipidemia is the presence of elevated levels of lipids and/or lipoproteins fractions (LDL-Cholesterol, TG and VLDL) in the blood. Hyperlipidemia is classified into two; familial (also called primary hyperlipidemia) caused by specific genetic abnormalities or acquired (also called secondary hyperlipidemia) when resulting from another underlying disorder that lead to alterations in plasma lipids and lipoprotein metabolism [1]. Hyperlipidemia has a diverse and complex etiology consisting of genetic, lifestyle, and environmental factors, It is not a disease but a metabolic derangement that can lead to many diseases, most notably cardiovascular diseases [2].

Significant ethnic differences exist in the prevalence and types of lipid disorders. While elevated serum Total-cholesterol and LDL-cholesterol are the main concern in Western populations, in other countries hypertriglyceridemia and low HDL-cholesterol are more prevalent [3]. The escalating trend of obesity, as well as changes in lifestyle and environmental factors have make lipid disorders a global medical and public health threat [4]. Elevated levels of LDL-cholesterol and lower level of HDL-Cholesterol are regarded as atherogenic (prone to cause atherosclerosis) [5]. This disease process leads to myocardial infraction, stroke and peripheral vascular diseases [6]. LDL particles are often termed “bad cholesterol” because they have been linked to atheroma formation. On the other hand, high concentration of functional HDL, which can remove cholesterol from cells and atheroma, offer protection and are sometimes referred to colloquially as “good cholesterol”. If these postulations were correct, then lowering blood lipid concentration should reduce mortality and morbidity from diseases associated with high lipid concentration such as heart disease and diabetes.

Khaya senegalensis A. Juss (Meliaceae) is commonly called the dry zone mahogany or African mahogany. The specific name means ‘of Senegal’, which is where the type specimen was collected and regarded as the most popular medicinal meliaceous plant in African traditional remedies [7]. The bitter bark extract have been used as a folk medicine for treatment of diabetes and lipid disorders [8], hypertension [9], jaundice [10], and malaria [11]. The bark extract has been used as an astringent for wounds and used occasionally for tanning because of the rich red color it provides. Roots are applied topically against stomach-ache, oedema and amenorrhoea, young twigs and roots are used as chewing sticks [12]. Fruits extracts have been shown to exhibit Antioxidative and hypolipidemic properties [13].

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Study animals

Fifty (50) male and female albino rats of three to four months weighting 80-100 g were purchased from the department of Biological Science, Bayero University Kano, they were housed in aluminum cages with saw dust at the bottom of the cage at an ambient temperature (temperature 25-30℃, photo period 12 hours natural light and 12 hours dark). The animals had free access to standard palletized grower feed and drinking water. Principle of laboratory animal care [14] and ethical guidelines for investigation of experimental pain in conscious animals [15] were observed during experimentation.

2.1.2 Plant material

Khaya senegalensis stem barks were collected from Bayero University Kano (located in the ancient city of Kano, North West of Nigeria). The plant was identified and authenticated at the Herbarium of Plant Biology Department, Bayero University Kano and was given a voucher number of (BUK/HAN/0116; identified and authenticated by Bala’uddeen Said Adam). The stem bark was shade dried and ground to powder.

2.2 Methods

2.2.1 Induction of hyperlipidemia

Cholesterol rich diet was formulated using the method of Vesselinvitch et al. [14] which is as follows: Pure cholesterol and palm oil were thoroughly mixed with the grower mash feed on a percentage ratio by weight of 2:20:78. The feed was given to the animals for a period of four weeks to induced hyperlipidemia prior to treatment. The weight gain in rats was noted.

2.2.2 Extract of *Khaya senegalensis* (ASBEKS) preparation

Two hundred gram (200 g) of the *Khaya senegalensis* stem bark powder was weighed and soaked in 500 ml of distilled water, the solution was shake vigorously and left to stand at room temperature for 24 hours. The mixture was filtered by passing through Whattman's Filter No. 1. The filtrate thus obtained was concentrated by complete evaporation of solvent using rotary evaporator to yield a dark brown residue. Five gram (5 g) of the dried sample was dissolved in fifty milliliters of distilled water to give concentration of 100 mg/ml. the volume to be administered to animals was calculated according to the method of Muhammad et al. [15].

> Volume to be administered (ml) = weight of rats (kg) × dose (mg/kg) / Concentration of the extract (mg/ml)

2.2.3 Experimental protocol

The fifty (50) rats were equally divided into:

Group I: Normal Control; they are none hyperlipidemic and no extract was given.
Group II: Hyperlipidemic control; no extract was administered.
Group III: Hyperlipidemic; administered with the ASBEKS extract at a dose of 100 mg/kg daily.
Group IV: Hyperlipidemic; administered with the ASBEKS extract at a dose of 200 mg/kg daily.
Group V: Hyperlipidemic; administered with the ASBEKS extract at a dose of 300 mg/kg daily.

At the end of the first week, five animals from each group were euthanized and blood sample of each rat was collected into a labelled centrifuge tube after which it was centrifuged and the serum was obtained for assay of lipid profile (Total cholesterol, LDL-cholesterol, HDL-cholesterol and Triglyceride). The treatment was continued for the rest of the animals and were euthanized at the end of the second week and serum was obtained for analysis of lipid profile. HDL and LDL-Cholesterol were assayed by the method of Friedward et al. [16], Triglycerides were assayed by the method of and Total Cholesterol were assayed by the method of Trinder [17].

2.3 Statistical Analysis

Results were expressed as mean ± standard deviation and analyzed using ANOVA, with p value <0.05 considered significant followed by Tukey´s post hoc test. A component of GraphPad Instat3 Software [18] version 3.05 by GraphPadInc was used to analyze the data.

3. RESULTS AND DISCUSSION

3.1 Results

The effect of the ASBEKS extract on body weight of hyperlipidemic rats after seven (7) and fourteen (14) days of administration was shown in Table 1. The weight of hyperlipidemic control rats was increased significantly ($p<0.05$) compared to normal control, Also the weight of rats treated with the ASBEKS extract falls significantly in group treated with 300mg/kg for one week and in all test groups treated with the ASBEKS extract for two weeks. Table 2 represent the effect of the ASBEKS extract on lipid profile (HDL-C., LDL, TC and TG) of hyperlipidemic rats after one week of ASBEKS treatment. The result shows a significant increase ($p<0.05$) in serum Triglyceride, LDL-Cholesterol and Total Cholesterol in hyperlipidemic control group compared to normal control, and a significant decrease ($p<0.05$) in Triglyceride, Total cholesterol and LDL-cholesterol in 300 mg/kg treated group (group V) was observed compared to hyperlipidemic control (group II). Table 3 represent the effect of the ASBEKS extract on lipid profile (HDL-C., LDL, TC and TG) of hyperlipidemic rats after two weeks of ASBEKS extract treatment. A significant decrease ($p<0.05$) in serum triglyceride, total cholesterol and LDL-cholesterol was observed in all treated groups (100 mg/kg, 200 mg/kg and 300 mg/kg body weight) compared to hyperlipidemic control in a dose dependent pattern.

Table 1. Effect of aqueous stem bark extract of *Khaya senegalensis* on body weight of hyperlipidemic rats

	Weight before induction (g)	Weight after induction(g)	Weight after 7 days treatment (g)	Weight after 14 days treatment (g)
Group I	96.66±2.88	122.33±2.51	126.30±2.30	130.00±2 .00
Group II	93.70±1.23	170.66±1.15	179.00±3.60[a]	188.33±2.88[a,b,c]
Group III	88.23±0.96	172.33±2.51	150.00±5.00	130.66±1.15[a]
Group IV	89.45±1.30	171.66±2.88	141.30±1.15	123.00±1.73[b]
Group V	90.50±2.05	173.00±1.73	131.60±2.88[a]	116.66±2.88[c]

Results are presented as Mean ± standard deviation, (n=10). Value with the same superscripts in a column are significantly different compared to each other (P<0.05), a: significantly different from hyperlipidemic group, b: significantly different from hyperlipidemic group, c: significantly different from hyperlipidemic group

Table 2. Effect of aqueous stem bark extract of *Khaya senegalensis* on lipid profile (HDL-C, LDL-C, TC and TG) of hyperlipidemic rats after 7 days of treatment

	TC (mmol/L)	LDL(mmol/L)	HDL (mmol/L)	TG (mmol/L)
Group I	4.27±0.06[a]	2.42 ±0.19[a]	1.08±0.07	1.57±0.02[a]
Group II	8.24±0.34[a,b]	4.96 ±0.23[a,b]	1.17±0.02	4.63±0.24[a,b]
Group III	6.25±0.27	2.85±0.14	1.45±0.06	4.26±0.62
Group IV	5.08±0.11	2.12±0.08	1.55±0.06	3.12±0.13
Group V	4.75±0.08[b]	1.89±0.16[b]	1.59±0.16	2.30±0.15[b]

Results are presented as Mean ± standard deviation, (n=5). Value with the same superscripts in a column are significantly different compared to each other (P<0.05). a: significantly different from control group, b: significantly different from hyperlipidemic group

Table 3. Effect of aqueous stem bark extract of *Khaya senegalensis* on lipid profile (HDL-C, LDL, TC and TG) of hyperlipidemic rats after 14 days of treatment

	TC (mmol/L)	LDL (mmol/L)	HDL (mmol/L)	TG (mmol/L)
Group I	4.99±0.13[a]	3.23±0.11[a]	0.97±0.07	1.65±0.08[a]
Group II	7.69±0.10[a,b,c,d]	4.7±0.27[a,b,c,d]	1.16±0.07[b]	4.08±0.30[a,b,c,d]
Group III	5.17±0.28[b]	2.47±0.44[b]	1.31±0.18	3.39±0.41[b]
Group IV	4.53±0.20[c]	1.40±0.24[c]	1.79±0.07	3.06±0.12[c]
Group V	4.06±0.09[d]	1.35±0.37[d]	2.04±0.08[b]	2.12±0.12[d]

Results are presented as Mean ± standard deviation, (n=5). Value with the same superscripts in a column are significantly different compared to each other (P<0.05). a: significantly different from control group, b: significantly different from hyperlipidemic group, c: significantly different from hyperlipidemic group and d: significantly different from hyperlipidemic group

3.2 Discussion

Body weight gain in hyperlipidemic rats was significantly higher than weight gain in normal control rats. This is an indication of successful induction of obesity as a result of four weeks feeding on high fats diet [19]. Treatment with different concentrations of ASBEKS significantly reduced weight gain by hyperlipidemic rats. Thus, this might be the reason why *Khaya senegalensis* is used traditionally by obese people to control weight, hence confirming earlier report of the use of *Khaya senegalensis* stem bark extract to regulate body weight gain [20].

Significant increase in blood cholesterol of animals fed with high cholesterol rich diet was observed when compared to normal control. Total cholesterol level of the normal control rats increased steadily from 4.27 mmol/L to 8.24 mmol/L in hyperlipidemic control, LDL-cholesterol also increases from 2.42 mmol/L to 4.96 mmol/L and triglyceride concentration increases from 1.57 mmol/L in normal control to 4.63 mmol/L in hyperlipidemic control. This is an indication of successful induction of hyperlipidemia as a result of intake of cholesterol rich diet. This is in conformity with the study of Ma et al. [21] who reported that feeding on high cholesterol rich diet have been positively related to

hypercholesterolemia and the risk of cardiovascular diseases.

The results for the effects of the extract on total cholesterol showed significant decrease in the amount of total cholesterol in group V (300 mg/kg) administered with the extract for one week and in all test (Groups III, IV and V; treated with 100 mg/kg, 200 mg/kg and 300 mg/kg) administered with the extract for two weeks compared to hyperlipidemic control. This suggested that *Khaya senegalensis* stem bark extract may have affected cholesterol biosynthesis which resulted to reduction in the level of cholesterol in the blood.

The low density lipoprotein cholesterol (LDL-Ch.) values obtained like that of cholesterol decreased significantly in group V after one week and in all test groups after two weeks of treatment with the extract. Epidemiologic surveys have shown a continuous linear relationship between LDL-cholesterol levels and chronic heart disease events. A similar relationship probably exists relating LDL-cholesterol levels to risk of ischaemic stroke [22].

High density cholesterol levels are reported to correlate inversely with the risk of coronary heart disease [23]. In the current study, the serum Triglyceride and HDL-cholesterol level decreases and increases respectively in hyperlipidemic treated groups compared to the hyperlipidemic control. The maximum efficacy of the extract was seen in group administered with the highest dose over two weeks period. The association between a low level of HDL-Cholesterol and an increased risk of CVD has been well established through epidemiology and clinical studies [24].

The possible mechanism of action of this extract on cholesterol metabolism has not been clarified. One possible mechanism may be *Khaya senegalensis* lowers the plasma and hepatic cholesterol concentrations by suppressing/inhibiting HMG-CoA reductase an enzyme that catalyzes the committed step in cholesterol synthesis [25]. Another possible mechanism may be through counteracting LDL-cholesterol by promoting the reverse cholesterol transport pathway through inducing an efflux of excess accumulated cellular cholesterol [26]. Also, TG lowering effect of *Khaya senegalensis* stem bark extract may contribute to inhibition of VLDL secretion by the liver [26] and increase VLDL clearance via lipoprotein lipase pathway [27,28].

4. CONCLUSION

It can be concluded that aqueous stem bark extract of *Khaya senegalensis* shows good anti-hyperlipidemic action against High fat diet induced hyperlipidemia.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chait A, Brunzell JD. Acquired hyperlipidemia (secondary dyslipoproteinemias). Endocrinol. Metab. Clin. North Am. 1990;19(2):259-78.
2. Durrington P. Dyslipidemia. Lancet. 2003; 362(9385):717-731.
3. Bell SJ, Bradley D, Forse RA, Bistrian BR. The new dietary fats in health and disease. J. Am. Dietetic Assoc. 1997;97:280–286.
4. Telmo Pereira. Dyslipidemia and cardiovascular risk: Lipid ratios as risk factors for cardiovascular disease, dyslipidemia - From prevention to treatment, Prof. Roya Kelishadi (Ed.). 2012; 31-39.
ISBN: 978-953-307-904-2
5. Lewington S. Blood cholesterol and vascular mortality by age, sex and blood pressure. Arm. J. Clin Path. 2007;29:55.
6. Brunzell JD. Lipoprotein management in patient with cardiometabolic risk. Pubmed. 2008;(12):957-61.
7. Danquah JA, Appiah M, Pappinen A. The effect of African mahogany species on soil chemical properties in degraded dry semi-deciduous forest ecosystems in Ghana. Int J Agric Biol. 2012;14:321–328.
8. Kolawole OT, Kolawole SO, Ayankunle AA, Olaniran OI. Anti-hyperglycemic effect of *Khaya senegalensis* stem bark aqueous extract in Wister rats. EJMP. 2012;2(1): 66-73.
9. El Badwi SMA, Bakhiet AO, Abdel Gadir EH. Haemato-biochemical effects of

aqueous extract of *Khaya senegalensis* stem bark on gentamicin-induced nephrotoxicity in Wistar Rats. J. Biol. Sci. 2012;12:361-366.
10. Sule MS, Abdulraheem RB, Aminu BM. Potency of aqueous stem bark extract of *Khaya senegalensis* against liver diseases in rats. BAJOPAS. 2008;(1):29-31.
11. Bickii J, Njifutie N, Foyere JA, Basco LK, Ringwald P. *In vitro* antimalarial activity of limonoids from *Khaya grandifoliola* C.D.C. (Meliaceae). J. Ethnopharmacol. 2000;69: 27–33.
12. Ijeoma JU, Idu M, Umar AH. Medicinal plant in use by the Fulani traditional herbalist in Yola North and Yola South L. G. A. of Adamawa State. J. Appl. Sci. Manage. 1997;1(1):59–63.
13. Kalpana K, Pugalendi KV. Antioxidative and hypolipidemic efficacy of alcoholic seed extract of *Khaya senegalensis* in streptozotocin diabetic rats. J. Basic Clin. Physiol. Pharmacol. 2011;22:11–21.
14. NIH. Guidelines for the care and use of laboratory animals. National Academic Press, (NIH Publication No. 85:23); 1996.
15. Zimmermann M. Ethical guidelines for investigation of experimental pain in conscious animals. Pain. 1983;19:109-110.
16. Vesselinvitch D, Wisseler RW, Schiffner TT, Borenaztajn I. The effect of various diet on atherogenesis in rhesus monkey. Atherosclerosis. 1980;35:187-207.
17. Muhammad IU, Alhassan AJ, Wudil AM, Jarumi IK. Toxicological and protective effect of aqueous stem bark extract of *Khaya senegalensis* (ASBEKS) on liver of experimental rat. BJAST. 2015;9(6): 600-605.
18. Friedwald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low density lipoprotein cholesterol in plasma, without use of preparative centrifuge. Clin Chem. 1972;18:499-502.
19. Trinder P. Cholesterol enzymatic end point manual. Ann. Clin. Biochem. 1969;6:23-28.
20. GraphPad Instat3 Software; 2000. Available: www.graphpad.com
21. Vesselinvitch D, Wisseler RW, Schiffner TT, Borenaztajn I. The effect of various diet on atherogenesis in rhesus monkey. Atherosclerosis. 1980;35:187-207.
22. Onu A, Saidu Y, Ladan MJ, Bilbis LS, Aleiro AA, Sahabi M. Effect of aqueous stem bark extrat of *Khaya senegalensis* on some biochemical, haematological and histopatological parameters of rats. J of Toixc. 2013;10:803-812.
23. Ma AZ, Ana B, Henri G, Paul H, Jose AM. Alterations in carbohydrate and lipid metabolism induced by a diet rich in coconut oil and cholesterol in a rat model. JCAN. 1999;18(1):36–42.
24. Zhang X, Patel A, Horibe H, Wu Z, Barzi F, Rodgers A. Cholesterol, coronary heart disease and stroke in the Asia Pacific region. Int J Epidemiol. 2003;32:563-72.
25. Stensvold L, Udar P, Thurmer H. High density lipoprotein cholesterol and coronary, cardiovascular and all-cause mortality among middle age Norwegian men and women. European Heart Journal. 1992;13:1155-1163.
26. Assmann G, Gotto AM. HDL cholesterol and protective factors in atherosclerosis. Circulation. 2004;109:1118-1148.
27. Nelson DL, Cox MM. Lehninger principles of biochemistry. 4th edition. W.H Freeman and company, New York. 2005;816-820.
28. Yokozawa T, Cho EJ, Sasaki S. The protective role of Chinese prescription kangen-karyu extract on diet induced hypercholesterolemia in rats. Biol. Pharm. Bull. 2006;29:760-765.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/14176