

Original Research Article**EFFECT OF AQUEOUS STEM BARK EXTRACT OF *KHAYA SENEGALENSIS*
(ASBEKS) ON LIPID PROFILE IN DIET INDUCED HYPERLIPIDEMIC RATS****ABSTRACT**

In this study, aqueous stem bark extract of *Khaya senegalensis* (ASBEKS) was administered to the 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 100mg/kg, 200mg/kg and 300mg/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 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.

Key words: High fats diets, Hyperlipidemic rats, Lipid profile and *Khaya senegalensis*

25 ~~1-0~~ INTRODUCTION

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

34 Significant ethnic differences exist in the prevalence and types of lipid disorders. While
35 elevated serum Total-cholesterol and LDL-cholesterol are the main concern in Western
36 populations, in other countries hypertriglyceridemia and low HDL-cholesterol are more
37 prevalent [3]. The escalating trend of obesity, as well as changes in lifestyle and
38 environmental factors have make lipid disorders a global medical and public health threat
39 [4]. Elevated levels of LDL-cholesterol and lower level of HDL-Cholesterol are regarded
40 as artherogenic (prone to cause atherosclerosis) [5]. This disease process leads to
41 myocardial infraction, stroke and peripheral vascular diseases [6]. LDL particles are often
42 termed “bad cholesterol” because they have been linked to atheroma formation. On the
43 other hand, high concentration of functional HDL, which can remove cholesterol from
44 cells and atheroma, offer protection and are sometimes referred to colloquially as “good
45 cholesterol”. If these postulations were correct, then lowering blood lipid concentration
46 should reduce mortality and morbidity from diseases associated with high lipid
47 concentration like 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].

~~2.0~~ MATERIAL AND METHODS

~~2.1~~ MATERIALS

~~2.1.1~~ STUDY ANIMALS

Fifty (50) male and female albino rats of three to four months weighting 80-100g 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 25-30⁰C, photo period 12 hours natural light and 12 hours dark). The animals had free access to standard palletized grower feed and drinking water.

~~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). 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 Vesselinitch *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.

of *Khaya senegalensis* (ASBEKS)

2.2.2 EXTRACT PREPARATION

Two hundred gram (200g) of the *Khaya senegalensis* stem bark powder was weighed and soaked in 500ml 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 (5g) of the dried sample was dissolved in fifty milliliters of distilled water to give concentration of 100mg/ml. the volume to be administered to animals was calculated according to the method of Muhammad *et al* [15].

$$\text{Volume to be administered (ml)} = \frac{\text{weight of rats (kg)} \times \text{dose (mg/kg)}}{\text{Concentration of the extract (mg/ml)}}$$

Weight of rats (kg) × dose (mg/kg)/Concentration of the extract (mg/ml)

2.3 EXPERIMENTAL PROTOCOL

The fifty (50) rats were grouped and treated as follows

94 **Group I:** Normal Control; they are none hyperlipidemic and no extract was given

95 **Group II:** Hyperlipidemic control; no extract was administered.

96 **Group III:** Hyperlipidemic; administered with the ^{ASBEKS} extract at a dose of 100mg/kg daily.

97 **Group IV:** Hyperlipidemic; administered with the ^{ASBEKS} extract at a dose of 200mg/kg daily.

98 **Group V:** Hyperlipidemic; administered with the ^{ASBEKS} extract at a dose of 300mg/kg daily.

99

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

108 ~~2.4~~ STATISTICAL ANALYSIS

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

113

114 ~~3.0 RESULTS AND DISCUSSIONS~~

115 ~~3.1~~ RESULTS

116 The effect of the ^{ASBEKS} extract on body weight of hyperlipidemic rats after seven (7) and
 117 fourteen (14) days of administration was shown in table 1. The weight of hyperlipidemic
 118 control rats ^{was} increases^{ASBKS} significantly ($p<0.05$) compared to normal control, Also the weight
 119 of rats treated with the ^{ASBKS} extract falls significantly in group treated with 300mg/kg for one
 120 week and in all test groups treated with the ^{ASBKS} extract for two weeks. Table 2 ^{represent} present the
 121 effect of the ^{ASBKS} extract on lipid profile (HDL-C., LDL, TC and TG) of hyperlipidemic rats
 122 after one week of ^{ASBKS} treatment. The result shows a significant increase ($p<0.05$) in serum
 123 Triglyceride, LDL-Cholesterol and Total Cholesterol in hyperlipidemic control group
 124 compared to normal control, and a significant decrease ($p<0.05$) in Triglyceride, Total
 125 cholesterol and LDL-cholesterol in 300mg/kg treated group (group V) was observed
 126 compared to hyperlipidemic control (group II). Table 3 ^{represent} present the effect of the ^{ASBKS} extract on
 127 lipid profile (HDL-C., LDL, TC and TG) of hyperlipidemic rats after two weeks of ^{ASBKS} extrac
 128 treatment. A significant decrease ($p<0.05$) in serum triglyceride, total cholesterol and
 129 LDL-cholesterol was observed in all treated groups (100mg/kg, 200mg/kg and 300mg/kg
 130 body weight) compared to hyperlipidemic control in a dose dependent pattern.

131 **Table 1: effect of aqueous stem bark extract of *Khaya senegalensis* on body weight of**
 132 **Hyperlipidemic rats ~~before and after induction of hyperlipidemia and after~~**
 133 **~~treatment.~~**

	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

134

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

137 a: significantly different from ----, b:significantly different from----, c:significantly different from -----

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

140

	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

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

143

144 a: significant different from----, b: significant different from-----, c: significant different from-----

145

146 **Table 3: effect of aqueous stem bark extract of *Khaya senegalensis* on lipid profile**
147 **(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 ^a	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 ^a	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).

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 4.27mmol/L to 8.24mmol/L in hyperlipidemic control, LDL-cholesterol also increases from 2.42mmol/L to 4.96mmol/L and triglyceride concentration increases from 1.57mmol/L in normal control to 4.63mmol/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 (300mg/kg) administered with the extract

for one week and in all test (Groups III, IV and V; treated with 100mg/kg, 200mg/kg and 300mg/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 increase VLDL clearance via lipoprotein lipase pathway.

4.0 CONCLUSION

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

5.0 CONSENT

It is not applicable.

REFERENCE

1. Chait A. and Brunzell J.D. (1990). Acquired hyperlipidemia (secondary dyslipoproteinemias). *Endocrinol. Metab. Clin. North Am.* 19(2): 259-78.
2. Durrington P. (2003). Dyslipidemia, *lancet* 362 (9385): 717-731.
3. Bell S.J. Bradley D. Forse R.A. and Bistrian B.R (1997).^Tthe new dietary fats in health and disease. *J. Am. Dietetic Assoc.* 97: 280–286.
4. Telmo Pereira (2012). Dyslipidemia and Cardiovascular Risk: Lipid Ratios as Risk Factors for Cardiovascular Disease, *Dyslipidemia - From Prevention to Treatment*, Prof. Roya Kelishadi (Ed.), ISBN: 978-953-307-904-2 Pp 31-39.
5. Lewington S. (2007).^r Blood cholesterol and vascular mortality by age, sex and blood pressure. *Arm. J. Clin path* 29:55

6. Brunzell J.D (2008). Lipoprotein management in patient with cardiometabolic risk. pubmed (12):957-61
7. Danquah J.A. Appiah M. and Pappinen A. (2012). The effect of African mahogany species on soil chemical properties in degraded dry semi-deciduous forest ecosystems in Ghana. Int J Agric Biol, 14: 321–328.
8. Kolawole O.T. Kolawole S.O. Ayankunle A.A. and Olaniran O.I. (2012). Anti-hyperglycemic Effect of *Khaya senegalensis* Stem Bark Aqueous Extract in Wister Rats. EJMP 2 (1): 66-73.
9. El Badwi S.M.A. Bakhiet A.O. and Abdel Gadir E.H. (2012). Haemato-biochemical Effects of aqueous extract of *Khaya senegalensis* stem bark on Gentamicin-Induced Nephrotoxicity in Wistar Rats. J. Biol. Sci. 12: 361-366.
10. Sule M.S. Abdulraheem R.B. and Aminu B.M. (2008). Potency of aqueous stem bark extract of *Khaya senegalensis* against liver diseases in rats. BAJOPAS (1): 29-31.
11. Bickii J. Njifutie N. Foyere J.A. Basco L.K. and Ringwald P. (2000). In vitro antimalarial activity of limonoids from *Khaya grandifoliola* C.D.C. (Meliaceae). J. Ethnopharmacol. 69: 27–33.
12. Ijeoma J. U. Idu M. and Umar A. H. (1997). 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. 1(1): 59 – 63.
13. Kalpana K. and Pugalendi K.V. (2011). Antioxidative and hypolipidemic efficacy of alcoholic seed extract of *Khaya senegalensis* in streptozotocin diabetic rats. J. Basic Clin. Physiol. Pharmacol. 22: 11–21.
14. Vesselinitch D. Wisseler R.W. Schiffner T.T. and Borenaztajn I. (1980). The effect of various diet on atherogenesis in rhesus monkey. Atherosclerosis. 35: 187-207.
15. Muhammad I. U. Alhassan A. I. Wudil A. M. and Jarumi I. K. (2015). Toxicological and Protective Effect of Aqueous Stem Bark Extract of *Khaya senegalensis* (ASBEKS) on Liver of Experimental Rat. BJAST 9(6): 600-605.
16. Friedwald W.T. Levy R.I. and Fredrickson D. S. (1972). Estimation of the concentration of low density lipoprotein cholesterol in plasma, without use of preparative centrifuge. Clin chem. 18: 499-502

263

264 17. Trinder P. (1969). Cholesterol enzymatic end point manual. Ann.clin.Biochem 6: 23-
265 28.

266

267 18. GraphPad Instat3 Software (2000). Available: www.graphpad.com

268

269 19. Vesselinitch D. Wisseler R.W. Schiffner T.T. and Borenaztajn I. (1980). The effect
270 of various diet on atherogenesis in rhesus monkey. Atherosclerosis. 35: 187-207.

271

272 20. Onu A. Saidu Y. Ladan M. J. Bilbis L. S. Aleiro A. A. and Sahabi M. (2013). Effect
273 of aqueous stem bark extrat of *Khaya senegalensis* on some biochemical, haematological
274 and Histophaological parameters of rats J of Toixc 10: 803-812.

275

276 21. Ma A.Z. Ana B. Henri G. Paul H. and Jose A. M. (1999). Alterations in Carbohydrate
277 and Lipid Metabolism Induced by a Diet Rich in Coconut Oil and Cholesterol in a Rat
278 Model. JCAN 18(1): 36-42.

279

280 22. Zhang X. Patel A. Horibe H. Wu Z. Barzi F. and Rodgers A. (2003). Cholesterol,
281 coronary heart disease and stroke in the Asia Pacific region. Int J Epidemiol 32:563 72.

282

283 23. Stensvold L. Udar P. and Thurmer H. (1992). High density lipoprotein cholesterol
284 and coronary, cardiovascular and all-cause mortality among middle age Norwegian men
285 and women. European Heart Journal 13:11555-1163

286

287 24. Assmann G. and Gotto A. M. (2004). HDL cholesterol and protective factors in
288 atherosclerosis. Circulation 109: 1118-11148

289

290 25. Nelson D.L. and Cox M.M (2204). Lehninger principles of biochemistry. 4th edition.
291 W.H Freeman and company, New York Pp 816-820.

292 26. Yokozawa T. Cho E.J. and Sasaki S. (2006). The protective role of Chinese
293 prescription kangen-karyu extract on diet induced hypercholesterolemia in rats. Biol.
294 Pharm. Bull. 29:760-765.

295