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Research Article
Antihyperlipidemic Potency of the Seed Extract of *Ricinodendron heudelotii* in Wistar Albino Rats

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Abstract

Background and Objective: *Ricinodendron heudelotii* seeds are widely used in Nigeria, West Africa as spices for various meals and also as a soup/sauce thickener, it is also believed to have some therapeutic properties. The ethanol seed extract of *Ricinodendron heudelotii* was investigated for its lipidemic activity in hyperlipidemia-induced albino rats. **Materials and Methods:** The rats were grouped into 6 of six rats per group. Five of these groups were fed with high fat diet. Three of the groups were thereafter treated with different concentrations of the extract. Rats fed with normal diet only and high fat diet without treatment were used as normal and negative controls, respectively while the positive control group was treated with a standard hyperlipidemic drug. Treatment was carried out for a period of 21 days, lipid profile assay was determined in blood obtained from the sacrificed rats. **Results:** The hyperlipidemic rats showed an increase in weight compared to the normal control. The result obtained showed variations amongst the groups. An increase in the total cholesterol level was observed in all groups in comparison with the normal control group, the high density lipoprotein concentration was also observed to increase with a corresponding decrease in the low density lipoprotein. There was statistically no significant difference at the $p<0.05$ between the test groups and the test controls, the total triglyceride level also increased across the test groups. **Conclusion:** It can therefore be suggested that the ethanolic seed extract of *Ricinodendron heudelotii* has antihyperlipidemic potency in wistar albino rats, hence its use therapeutically.

Key words: *Ricinodendron heudelotii,* hyperlipidemia, cardiovascular, HDL, LDL, cholesterol

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Hyperlipidemia is a disease condition that is prevalent in our society due to various unhealthy life styles amongst humans. It has been associated as a risk factor to various other diseases[1] and conditions such as; hypertension, acute coronary syndrome, stroke and chronic heart failure. It has been reported by Yusuf *et al.*[2] that the increase in cardiovascular diseases in developing countries can be attributable to an increase in the occurrence of atherosclerotic diseases, urbanization and higher risk factor levels such as; obesity, diabetes, dyslipidemia and hypertension. Various experimental animal researches[3-5] observed that hypercholesterolemia is common risk factor for cardiovascular diseases and its associated conditions, hence, a foremost treatment towards reduction in hypercholesterolemia may reduce the risk of cardiovascular diseases[6].

The use of synthetic drugs in the treatment of diseases, although effective, poses health side effects such as; hepatic diseases, gastric irritations, diarrheal and nausea[6]. The use of alternative and complementary medicine in the treatment of diseases due to its affordability, less or no side effect and its availability has been encouraged by the World Health Organization[7]. Several plant parts have been reported to be useful in the treatment of diseases due to their phytochemical constituent which has a similar mechanism of action, same with the synthetic drugs. One of such plants is the seed extract of *Ricinodendron heudeotii* commonly called Njangsa in Nigeria, West Africa[8].

This study therefore investigates the antihyperlipidemic potency of the seed extract of *Ricinodendron heudelotii* in hyperlipidemic Wistar albino rats.

MATERIALS AND METHODS

The study was carried out in the laboratory and animal house unit of Biochemistry Department, Rivers State University from July-December, 2018.

Thirty six albino rats of weight 180-250 g were used for the lipidemic study.

The rats were weighed and allowed to acclimatize for a period of 7 days. After acclimatization, hyperlipidemia was induced by feeding them with a high fat diet: a mixture of pure butter with coconut oil in a ratio of 1:2 (20 g of butter melted in 40 mL of coconut oil). Almost 400 mg kg^{-1} of the diet was administered for two weeks to the selected groups after which hyperlipidemic assessment was done. Hyperlipidemia was induced in the rats by single daily oral dose of 10m/kg body weight in addition to normal diet for the entire experimental period[9].

Experimental design: The thirty six albino rats were divided into six groups of six rats per group. The design was as follows:

- **Group A:** The rats were fed with normal feed and water only. It served as normal control
- **Group B:** The rats were fed with normal feed and water, induced with the high fat diet and were treated using a standard hyperlipidemic drug, Simvastatin. It served as positive control
- **Group C:** The rats were fed with normal feed and water, induced with the high fat diet but were not treated. This served as negative control
- **Group D:** The rats were fed with normal feed and water, induced with the high fat diet and were treated with a dose of 400 mg/kg/b.wt. of *R. heudelotii* ethanol seed extract
- **Group E:** The rats were fed with normal feed and water, induced with the high fat diet and were treated with a dose of 600 mg/kg/b.wt. of *R. heudelotii* ethanol seed extract
- **Group F:** The rats were fed with normal feed and water, induced with the high fat diet and were treated with a dose of 800 mg/kg/b.wt. of *R. heudelotii* ethanol seed extract

Assessment of lipid profile: The rats were weighed weekly and mean weight was obtained and recorded after which they were sacrificed by decapitation after an overnight fast. Blood samples were collected from the heart by cardiac puncture in clean specimen bottles and the serum was immediately separated and stored until used for analysis of lipid profile. This was done 24 h after the last treatment.

After separation of serum from blood, the various parameters of lipid profile were estimated using standard laboratory procedures for lipid profile parameters; Total Cholesterol (TC), Triglycerides, (TG), Low Density Lipoprotein Cholesterol (LDL) and High Density Lipoprotein Cholesterol (HDL). Serum LDL was estimated by calculation[9].

$$\text{LDL (mg dL}^{-1}\text{)} = \text{Total cholesterol-HDL-TG/5}$$

Method of preparation of simvastatin suspension: The stock solution was prepared by dissolving 20 mg of simvastatin in 70 mL of normal saline and used as a standard drug in a dose of 1.8 mg/kg/b.wt. The daily dose of simvastatin for rats was calculated by extrapolation from the human dose (20 mg day^{-1})[10].

Statistical analysis: Values were given as Means±Standard Deviation (Mean±SD). Data was statistically analyzed by using one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Results of the lipidemic activity of ethanol seed extract of *Ricinodendron heudelotii* on Wistar albino rats are as shown in this study. Table 1-3 showed the mean weight represented in percentage difference of the Wistar albino rats before and after acclimatization, before and after inducement with high fat diet and treatment with seed extract of *Ricinodendron heudelotii* respectively. Table 3 showed a significant increment in the weight of the rats when given a high fat diet meal to induced hyperlipidemia. This is in agreement with the Friedewald *et al.*[11] and Ezekwe *et al.*[12], who stated the rich content of *Ricinodendron heudelotii* in Omega-3-fatty acid. The assay for the lipid profile of the rats after inducement of hyperlipidemia revealed an increased level of TC and HDL, while LDL level decreased in comparison with the control group. This may be due to the high fat diet which comprises of high level of saturated fatty acid, thereby leading to an decreased level of the LDL which is also known as the bad cholesterol. In Table 3, an increase in the mean weight of the rats were recorded, however, the lipid profile analysis as shown in Table 4 showed a decreased level of LDL and an increased level of HDL which is also known as the good cholesterol.

The results for the effects of the seed extract on total cholesterol showed an elevation of total cholesterol levels in all groups administered with *Ricinodendron heudelotii* ethanol seed extract in Table 4. Comparing the positive and negative controls to the normal, a slight increase was observed for the former and a drastic decrease was observed for the latter. It was also observed that the dosage of 400 mg kg^{-1} yielded the lowest TC value and 600 mg kg^{-1} yielded the highest TC value amongst the treated groups. *Ricinodendron heudelotii* seed components have been analyzed and found to contain a high content of fatty acid (47.4-55.30%). The insignificant elevation of cholesterol could be attributed to the low level of saturated fatty acids (13.5%) and non-detection of Trans fats[12]. There were increased TC levels with increase in concentration of the seed extract. A compositional analysis of *Ricinodendron heudelotii*[12] revealed a unique nutrient presence of long chain omega-3 fatty acids not usually associated with plant materials, almost entirely of eicosapentaenoic acid, with about 18% oleic acid. The LDL result was also reported as seen in Table 4. The LDL which has been reported to slowly build in the arteries, making them narrower, thereby increasing the risk of coronary heart diseases, as it combines with other substances in the blood to form plagues that stick to the walls of arteries and called atherosclerosis[13]. The result of LDL showed a decreasing trend in all the experimental groups compared with the control. *Ricinodendron heudelotii* has high oil content (45-55%), 52% alpha-eleostearic fatty acid, which is a conjugated linolenic fatty acid[14]. However, the trend observed for HDL showed an increase in the concentration of HDL at group 4 experimental animal concentration. The HDL helps removal of excess cholesterol from blood stream and returns it to the liver where

Table 1: Mean weight of Wistar albino rats before and after acclimatization and their percentage difference

Groups	Initial weight	Final weight	Difference (%)
A	90	90	0.0
B	80	85	6.3
C	90	97	7.7
D	100	100	0.0
E	100	105	6.3
F	95	105	10.5

Table 2: Mean weight of Wistar albino rats before and after inducement with high fat diet and their percentage difference

Groups	Initial weight	Final weight	Increase (%)
A	90	98	8.9
B	85	110	29.4
C	97	120	23.7
D	100	120	20.0
E	105	125	19.0
F	105	122	16.2

Table 3: Mean weight of Wistar albino rats before and after treatment with seed extract of *R. heudelotii* and their percentage difference

Groups	Initial weight	Final weight	Percentage
A	98	108	10.2
B	110	125	13.6
C	120	135	12.5
D	120	150	25.0
E	125	146	16.8
F	122	152	24.6

Table 4: Lipid profile of Wistar albino rats administered the seed extract

	Lipid profile parameters			
Groups	TC (mmol L^{-1})	TG (mmol L^{-1})	HDL (mmol L^{-1})	LDL (mmol L^{-1})
A	2.84±0.45^a	1.09±0.20^a	0.69±0.26^a	1.87±0.19^a
B	3.18±0.58^a	1.22±0.31^a	0.71±0.3^a	1.64±0.37^a
C	3.24±1.29^a	1.38±0.91^a	0.73±0.52^a	1.52±0.69^a
D	3.46±0.73^a	1.57±0.57^a	0.85±0.19^a	1.32±0.28^a
E	3.70±0.95^a	1.65±0.39^a	0.82±0.34^a	1.49±0.38^a
F	3.42±0.81^a	1.67±0.22^a	0.87±0.32^a	1.30±0.46^a

TC: Total cholesterol, TG: Triglycerides, LDL: Low density lipoprotein, HDL: High density lipoprotein, Values are expressed as Mean±Standard deviation, values with different superscripts show significant difference at the 0.05 level, values with the same superscripts show no significance at the 0.05 level

it is broken down and passed out of the body[14]. An increasing trend in HDL concentration was observed in all the groups in comparison with the control group. The high oil content of the seed may have led to the increment in the weight of the animal while the reduction in level of LDL and a complementary increase in level of HDL might be attributed to the presence of the conjugated fatty acid in the seed and also the high level (85%) polyunsaturated fatty acids (PUFAs) present in the seed. These results therefore suggested that an increase in TC level was a good indication as only the HDL was increased while the LDL decreased.

The results for the effects of the seed extract on triglyceride levels showed a similar trend to that of total cholesterol. Elevation of TG levels was observed in all groups administered with *R. heudelotii* ethanolic seed extract and the dose of 800 and 600 mg kg^{-1} yielded the lowest and highest TG value, respectively amongst the treated groups. Comparing the positive and negative controls to the normal, there was elevation of TG values. Excess calories, alcohol or sugar in the body turn into triglycerides and are stored in fat cells throughout the body. Increase in triglyceride level in the treated animals could be related to the high amount of saponins in the extract which was determined via phytochemical analysis[8]. Saponins are known as amphipathic glycosides (sugar moieties that are both fat loving and water loving). Results obtained for High Density Lipoprotein (HDL) showed an elevation of HDL levels in all treated groups compared to all the control groups. Triglycerides and cholesterol are separate types of lipids that circulate in the blood. Triglycerides stores unused calories and provide the body with energy while cholesterol is used to build cells and certain hormones. Because triglycerides and cholesterol cannot dissolve in blood, they circulate throughout the body with the help of proteins that transport the lipids (lipoproteins). With the help of HDL, packets of cholesterol are formed to help move cholesterol through the blood. The HDL helps remove cholesterol from the body by transporting it to the liver. The LDL does not aid in the transportation of cholesterol out of the body, instead it deposits cholesterol onto the vessel wall. LDL molecules contain much more cholesterol than HDL molecules. Therefore, having much more of LDL molecules than HDL molecules will lead to dumping of lumps of cholesterol and triglycerides along vital blood vessels. When prolonged, it will lead to conditions that cause cardiovascular diseases[15].

CONCLUSION

This study evaluated the effect of *Ricinodendron heudelotii* on the lipid profile of Wistar albino rats. The results obtained suggest the ameliorative potency of the seeds of *Ricinodendron heudelotii* against induced hyperlipidemia in Wistar albino rats, hence its use therapeutically in folkloric medicine and also a rich source of high density lipoprotein, which is known as the "good cholesterol".

SIGNIFICANCE STATEMENT

This study discovered the ameliorative potency of the seed extract of *Ricinodendron heudelotii* for cardiovascular diseases and its attending complication, as it was seen to reduce the LDL level while increasing the HDL level of hyperlipidemic experimental animals. This is due to the composition of polyunsaturated fatty acid of *Ricinodendron heudelotii,* which gives the seeds its therapeutic potency. This study will help further studies into isolating the possible bioactive compounds in the seed responsible for the antilipidemic potency.

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