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Effect of the *Garcinia kola* Seed on Serum Lipids in Adult Subjects

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Authors' contributions

This work was carried out in collaboration among all authors. Author MG design of the study, supervision of data collection, data interpretation and validation of the manuscript. Authors TS, SZ and GD collect, process, analysis the data and wrote the draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: Many studies have reported the lipid-lowering effect of the *Garcinia kola* seed in experimental animals.
Objective: Assessing the effect of daily intake of *Garcinia kola* seed on serum lipids in adult subjects.
Methods: This research work was an intervention study based on a quasi-experimental approach carried out over a three-month period i.e. from May 1 to July 30, 2019. The study sample consisted of 40 adult subjects (18 men and 22 women) who gave their written informed consent to participate to in the study. After receiving required information, each subject underwent a baseline lipid test consisting of total cholesterol (TC), HDL cholesterol (HDL-C), LDL cholesterol (LDL-C) and triglycerides. Then, each subject consumed every day one *Garcinia kola* seed during 90 days. Every 30 days, a lipid test was performed. TC, HDL-C and triglycerides were determined using end-point colometric enzyme assay**.** LDL-C was estimated using the formula of Friedewald. Student's t test helped compare the mean values of lipid parameters at the beginning and at the end of the experiment at the threshold of 5%.

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Results: At the beginning and at the end of the experiment, the mean values in g/L of TC (1.68±0.35 vs 1.60±0.31), HDL-C (0.53±0.13 vs 0.51±0.14), LDL-C (0.97±0.36 vs 0.94±0.34) and triglycerides (0.91±0.50 vs 0.72±0.33) were not significantly different ($p > 0.05$). However, we noted a downward trend in those values over time during the experiment.
Conclusion: The daily consumption of *Garcinia kola* seed improves serum lipid profile. The use of that seed is a potential alternative to the conventional treatment of dyslipidemia.

Keywords: Garcinia kola; lipids; cholesterol; Benin.

1. INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of mortality worldwide. More than three quarters of those deaths occur in low or middle-income countries. The populations of those countries often do not have the opportunity to benefit from integrated primary health care programs for early diagnosis and treatment of risk persons, compared to populations of high income countries [1]. The burdens induced by CVDs, for which cases of dyslipidemia represent a biological risk factor, increase so rapidly. For instance, CVDs have serious socioeconomic consequences in terms of health care cost, absenteeism and national productivity on the individuals, families and communities. In Africa, those diseases have become a public health concern due to the epidemiological transition that the continent is experiencing [2].

The management of dyslipidemia requires hygiene and dietary measures as well as daily use of synthetic molecules. The search for solution by using local resources represents an alternative to care provision to patients with dyslipidemia. The use of medicinal plants remains an endogenous resource to be valued and promoted in Africa. Indeed, those plants provide a significant variety of therapies [3] and some of them have an impact on the lipid parameters.

Also called bitter cola or little kola, *Garcinia kola* (family: Guttiferae, sub-family: Clusoideae) is a tree widely planted in the forests of West and Central Africa [4]. It is recognized for its relevant value and usefulness at economic, food, nutritional, health, social, cultural, cosmetic and pharmaceutical levels, etc [5,6]. The different parts of the plant are used for a proven medicinal purpose in the African pharmacopeia [7,8].

Several previous research works [9-11] have focused on the effects of extracts of *Garcinia kola* seeds on lipid metabolism in experimental animals. The study conducted by Adaramoye and Adeyemi [9] has emphasized the lipid-lowering effects of slices of kolaviron (a biflavonoid of *Garcinia kola*) in rats. The administration of extracts of *Garcinia kola* seed to hyperlipemia-induced rats has showed that, after 21 days, total cholesterol, triglycerides and LDL cholesterol were significantly lower compared to the control group in the works of Adejor et al. [10]; the same authors observed a significant increase in HDL cholesterol, and a decline in the atherogenic index of plasma among the same population of rats. Uche and Osakpolor [11] reported an improvement of dyslipidemia through a decline in rates of total cholesterol, HDL cholesterol and triglycerides among rats after administration of *Garcinia kola* seed extracts.

Garcinia kola seed is consumed on a daily basis by some populations of Benin, alone as a chewed substance or combined with other plants; it is a veritable functional food.

This study aimed to assess the effect of daily consumption of *Garcinia kola* seed on serum lipids among adult subjects in order to find an alternative to the drug therapy of dyslipidemia.

2. MATERIALS AND METHODS

2.1 Plant Material

It consisted of *Garcinia kola* seeds obtained in different local markets of Benin. After identification at the Botany Laboratory of the Faculty of Agricultural Sciences of the University of Parakou, the seeds were stored in jute bags to keep trees from drying out.

2.2 Type and Time Period of Study

We have carried out an intervention study based on quasi-experimental approach. The data were collected over a time period of three months running from May 1 to July 30, 2019.

2.3 Study Population

It consisted of adult subjects from both sexes, volunteers, who gave their written informed

consent to participate to the study. In addition, the study subjects were aged 18 to 60 years and lived in Parakou (Republic of Benin) during the data collection period; they had a normal kidney and liver function test.

This study did not include subjects with chronic alcoholism, suffering from liver or kidney diseases, on any kind of drug therapy likely to impact on lipid parameters, as well as pregnant women. Our research work also excluded subjects with incomplete follow-up, and resolved to withdraw from the study, as well as women with normal ongoing pregnancy after the initiation of the study.

2.4 Sampling

We made a systematic census of all the adult subjects who volunteered for this study during the data collection period, and meeting the inclusion criteria. This research work focused on 40 adult subjects (18 men and 22 women).

2.5 Data Collection

After the selection of the subjects who met the inclusion criteria and presenting with normal values of creatininemia and aminotransferasemia (ASAT and ALAT), the data were collected by means of direct measurement of the anthropometric and blood collection to determine lipid parameters. Atherogenic index of plasma (AIP) was calculated using the formula log (triglycerides/HDL cholesterol).

2.6 Experiment

The selected respondents were subject to the measurement of their anthropometric parameters (blood pressure, weight, size, waist circumference, hip circumference) and determination of initial lipid parameters (total cholesterol, HDL cholesterol, triglycerides and LDL cholesterol). Then, each subject consumed, by chewing it, one seed (20 grams) of *Garcinia kola* per day during 90 days, without taking into account the time of the day concerned and feeding pattern. Finally, the same anthropometric measurements and lipid parameters as the initial ones were determined every 30 days during the 90 days. During the experiment, the study subjects kept their ordinary lifestyle.

For the determination of lipid parameters, venous blood samples (4 mL) were collected in the morning among subjects fasting for at least 12 clock hours. The blood sample collected thereby, were centrifuged at 4000 revolutions per minute (rpm) during 5 minutes, then serums were decanted for the determination of lipid parameters on the same day. Total cholesterol, HDL cholesterol and triglycerides were determined by means of endpoint colometric method for assaying enzyme using the reagents ELITech® kit (ELITech Clinical Systems, France) on the automated SELECTRA PROS ELITech Clinical Systems (Dieren, The Netherlands). LDL cholesterol was estimated using the formula of Friedewald et al. [12] provided that triglyceridemia is lower than 3.5 g/L.

2.7 Data Processing and Analysis

The data were processed and analyzed using the software SPSS 25 (2018 version). The software Microsoft Office Excel (2016 version) was used to create curves and graphs. The quantitative variables were expressed as average ± standard deviation when distribution is normal and the qualitative ones as population size and percentage. The analysis of the variance (ANOVA) helped compare the mean values of the parameters harvested every 30 days during the 90 days. Student's t test served to compare the mean values of lipid parameters of the study initiation to those of the end of the experiment. Significance level chosen was 5%.

3. RESULTS

3.1 General Characteristics of the 40 Subjects Involved in the Study

Table 1 shows the general characteristics of the 40 subjects involved in the study.

3.2 Lipid Parameters in Men

Among men, at the end of the experimentation, *Garcinia kola* reduced total cholesterol, LDL cholesterol and triglycerides but not significantly ($p > 0.05$). As far as HDL cholesterol is concerned, values remained stable i.e. unchanged (Table 2).

Fig. 1 shows a downward trend in the total cholesterol, LDL cholesterol and triglycerides whereas HDL cholesterol level did not change.

3.3 Lipid Parameters in Women

Among women, at the end of the experiment, there was no significant difference between the mean values of the lipid parameters recorded and the initial ones ($p>0.05$) (Table 3).

Table 1. General characteristics of the 40 subjects involved in the study

	Characteristics
Sex M/F (n)	18/22
Mean age (years)	36.10±12.52
Mean BMI (kg/m^2)	24.05±3.99
Average waist circumference (cm)	86.00±12.09
Average hip circumference (cm)	97.13±11.91
Mean systolic blood pressure (mmHg)	116.25±16.75
Mean diastolic blood pressure (mmHg)	78.50±10.99
Mean creatinine (mg/L)	9.36±2.44
Mean aspartate aminotransférase (U/L)	28.46±11.52
Mean alanine aminotransferase (U/L)	27.19±15.77

Table 2. Mean value ± standard deviation (g/L) of lipid parameters of the 18 male subjects during three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

	M_0	M_1	M_2	M_3	P	P*
Total cholesterol	1.79±0.35	1.73±0.30	1.74±0.26	1.64±0.26	0.459	0.141
HDL cholesterol	0.51±0.16	0.52±0.18	0.50±0.17	0.53±0.15	0.963	0.746
Triglycerides	1.07±0.54	0.99±0.36	0.86±0.33	0.82±0.34	0.231	0.105
LDL cholesterol	1.07±0.40	1.00±0.35	1.08±0.37	0.93±0.33	0.568	0.253

M (month); P (ANOVA); P (comparison of values M_0 and M_3)*

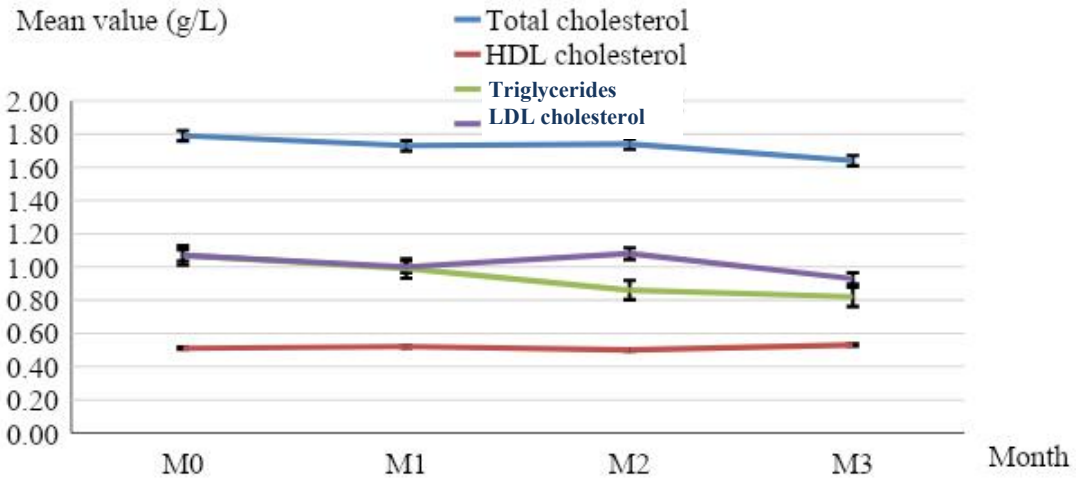

Fig. 1. Variations in the lipid parameters of the 18 male subjects during the three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

Table 3. Mean value ± standard deviation (g/L) of the lipid parameters of the 22 female subjects during three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

	M_0	M_1	M_2	M_3	P	P*
Total cholesterol	1.58±0.33	1.55±0.34	1.61±0.40	1.58±0.35	0.960	0.954
HDL cholesterol	0.54±0.11	0.55±0.12	0.49±0.13	0.50±0.13	0.347	0.247
Triglycerides	0.78±0.44	0.71±0.35	0.61±0.28	0.65±0.31	0.411	0.263
LDL cholesterol	0.88±0.32	0.87±0.33	1.02±0.37	0.95±0.35	0.448	0.539

M (months); P (ANOVA); P (comparison of values M_0 and M_3)*

The growth chart of lipid parameters shows that total cholesterol and HDL cholesterol remained at a stable level. By contrast, a downward trend in triglycerides and an upward trend in LDL cholesterol were observed (Fig. 2).

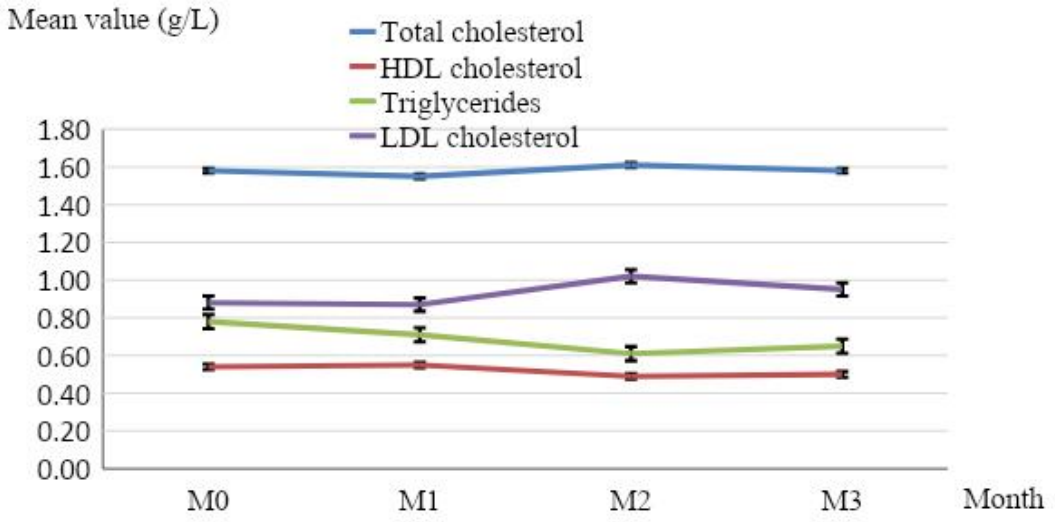

Fig. 2. Variations in the lipid parameters of the 22 female subjects during three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

Table 4. Mean value ± standard deviation (g/L) of lipid parameters of the 40 subjects during three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

	M_0	M_1	M_2	M_3	P	P*
Total cholesterol	1.68±0.35	1.63±0.33	1.67±0.35	1.60±0.31	0.738	0.324
HDL cholesterol	0.53±0.13	0.53±0.15	0.50±0.15	0.51±0.14	0.632	0.623
Triglycerides	0.91±0.50	0.83±0.38	0.72±0.32	0.72±0.33	**0.017**	0.113
LDL cholesterol	0.97±0.36	0.92±0.34	1.04±0.36	0.94±0.34	0.421	0.714

M (months); P (ANOVA); P (comparison of values M_0 and M_3)*

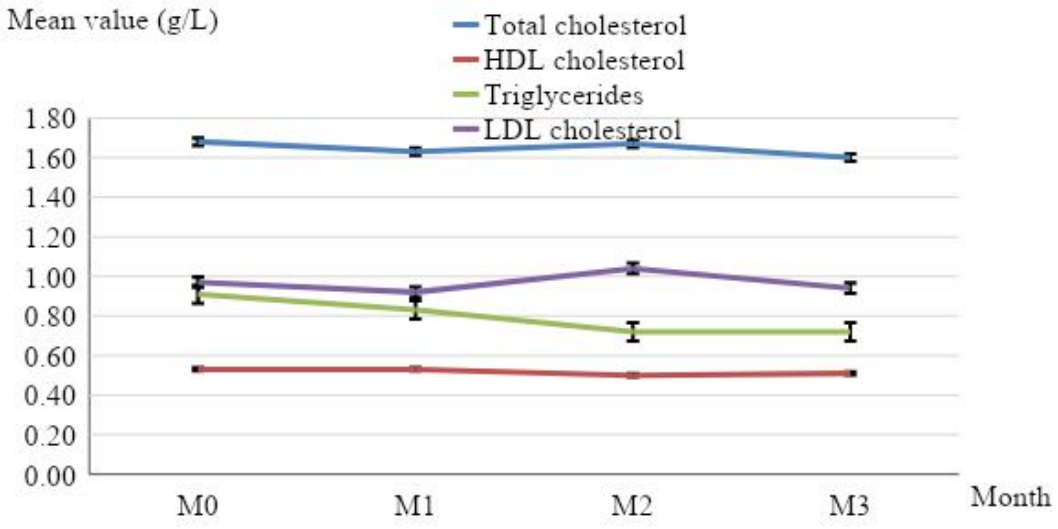

Fig. 3. Variations in the lipid parameters of the 40 subjects during the three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

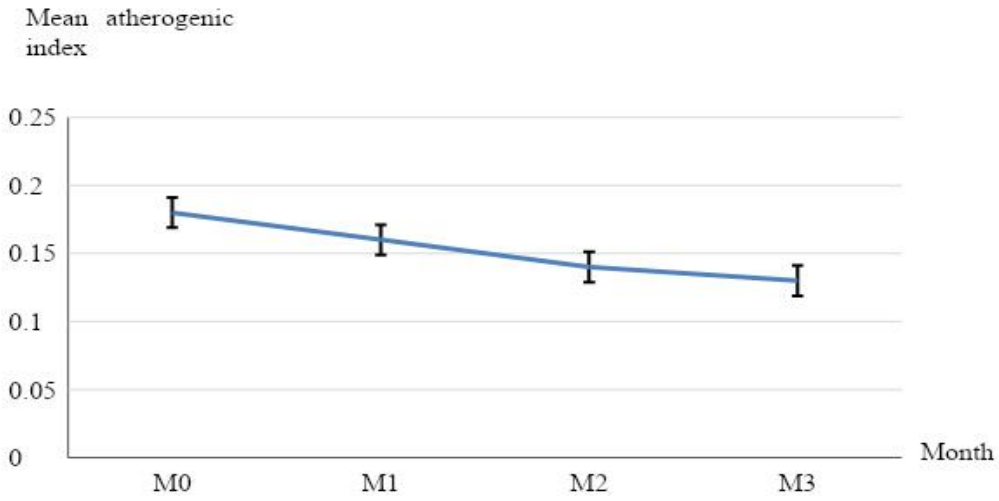

Fig. 4. Variations in the atherogenic index of plasma of the 40 subjects during three months of daily consumption of one seed of *Garcinia kola*, Parakou, 2019

3.4 Lipid Parameters in Both Sexes

At the end of the experiment, the consumption of one seed of *Garcinia kola* reduced the mean values of lipid parameters without significant difference ($p>0.05$) (Table 4).

A downward trend was noted in the mean values of the lipid parameters during the three months of follow-up of the 40 subjects in Parakou in 2019 (Fig. 3).

At the end of the experimentation, the atherogenic index of plasma of the 40 subjects declined but without significant difference ($p = 0.338$) (Fig. 4).

4. DISCUSSION

After three months of daily consumption of one *Garcinia kola* seed, the mean value of the lipid parameters decreased in the 40 subjects but without significant difference. In fact, the study of variations in the growth curves of total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides showed a downward trend in the mean values of the lipid parameters of those subjects. The only study found in the literature carried out among human beings is the one of Tamuno-Emine et al. [13]. The research protocol used by those authors was different from ours. For instance, their sample consisted of 10 subjects who consumed everyday two seeds of *Garcinia kola* during 10 days. As a result of their study, a significant increase was noted in total cholesterol and HDL cholesterol after the 10 days of consumption of *Garcinia kola*.

Moreover, several experimental researches related to the effect of *Garcinia kola* seed on serum lipids were carried out on animals [10,14,15]. Adaramoye et al. [14] have reported that the oral administration during 3 to 7 days of kolaviron (a biflavonoid extracted from the *Garcinia kola* seed) to alloxan-induced diabetic rats, results in the lowering of triglycerides, total cholesterol and LDL cholesterol. Duze et al. [15] found out a decline in the LDL cholesterol among diabetes-induced rats compared to the focus group, after oral administration during four weeks of 300 mg/kg of extracts of *Garcinia kola* seed. The administration of extracts of *Garcinia kola* seed (200 mg/kg) to hyperlipemia-induced rats in the research works of Adejor et al. [10] showed that after 21 days, total cholesterol, triglycerides and LDL cholesterol were significantly lower compared to control group among the same population of rats. Omeh et al. [16] had published a trial on Wistar albino rats fed with foods fortified with *Garcinia kola* powder of concentrations graduated at 5%, 10%, 20% et 50% during 21 consecutive days. In that trial, they reported that the *Garcinia kola* seed caused a significant decrease ($p <0.05$) in the dependent dose of rates of total cholesterol, LDL cholesterol and triglycerides whereas HDL cholesterol increased significantly. In light of these different results, it can be said that the *Garcinia kola* seed improves the serum lipid profile to limit the atherogenesis.

Although the mechanisms of the lipid-lowering effect of *Garcinia kola* seed are not well known, many hypotheses may be referred to or considered. i) Reduced absorption of cholesterol in the intestine [17,18]: the possible mechanism of reduced absorption of dietary cholesterol by the intestine is a connection of phytosterols (steroids found out in the *Garcinia kola* seed) with the cholesterol receptor site in the intestinal mucosa and with bile acids of the intestine which impede their re-absorption. As a result, there is a reduction of the pool of bile acids; this will lead to an activation of the cholesterol 7-α-hydroxylase and increased conversion of cholesterol into bile acids. ii) Reduction in the biosynthesis of cholesterol by flavonoids: through inhibition of HMG-CoA reductase [19]. iii) Inhibition of cholesterol production in the liver, stimulation of cholesterol secretion into bile or declined lipogenesis and increased catabolism of lipids [17-19].

As in our study, the administration of extracts of *Garcinia kola* seed (200 mg/kg) to hyperlipemia-induced rats showed, after 21 days, showed a decline in the atherogenic index of plasma (AIP) among the same population of rats [10]. Udenze et al. [20] got the same results in alloxan-induced rats with diabetes. As these observations indicate, *Garcinia kola* seed reduced AIP in both human being and experimental animals.

5. CONCLUSION

The daily consumption of *Garcinia kola* seed improves serum lipid profile. For instance, the rate of serum lipids declines after 90 days of intake of one seed of *Garcinia kola*.

Therefore, the *Garcinia kola* seed may be used as a local solution in the prevention and management of risk factors for cardiovascular diseases, particularly the cases of dyslipidemia. This pilot study should be continued using a larger sample over a longer time frame.

CONSENT

All authors declare that 'written informed consent was obtained from participants of this study'.

ETHICAL APPROVAL

The research protocol developed for this study has been approved by the Local Ethics Committee for Biomedical Research of the University of Parakou (Decision No. 0191/ CLERB-UP/P/SP/R/SA).

All authors hereby declare that "all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki."

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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