Lipid Profile of a Population of Jacqueville, Consumer of Palm Oil in Southern Côte d'Ivoire

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Authors' contributions

This work was carried out in collaboration among all authors. Author MLAB designed the study, wrote the article protocol and gave final approval for the version to be published. Author NFB was conducted research, participated in the design and acquisition of data, article writing, analysis and interpretation of data. Author AFF helped design and acquire the data. Author KJMD contributed to the interpretation of the data. Author KYASZ contributed to the statistical analysis of the data and Author KEA contributed to the analysis of the study. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aims: The main aim of this study is to describe the profile of lipids serum in an active and apparently healthy population consuming palm oil in the department of Jacqueville in the south of Côte d'Ivoire

Methodology: We focused on 83 apparently healthy volunteers, which ages ranged between 18 to 50 years old. Within that population, 43 of them were palm oil consumers (67 g / day) while 40 others were considered as population control (30 g / day). We determined the BMI as well as blood pressure. Furthermore, we used conventional enzyme methods to measure the total cholesterol, HDL cholesterol, LDL cholesterol, and triglycerides.

Results: Our results shown that, the mean BMI of palm oil consumers did not vary significantly compared to the control population. However, the two groups of subjects were overweight and both

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group were in hypotension and the other hand the mean values of the lipid parameters did not vary significantly between the two study groups. In addition, the mean values of the lipid parameters (CT, C-LDL and TG) were normal in the two groups. With the exception of C-HDL, which value was lower than the reference one at the level of the two groups.

Conclusion: This study did not show any influence of palm oil consumption on the mean BMI, blood pressure and lipid profile of the population.

1. INTRODUCTION

Oil palm is known to have a production yield, four time higher than colza and ten time higher than soybeans while it has the lowest production cost within the vegetable oils which is 20% lower than the soybeans and much more lower than the rapeseed [1]. Indeed, currently the oil extracted from the oil palm is the vegetable oil the most consumed through the world [2,3]. The culinary use of the different forms of palm oil as an ingredient in much of the Western African and Eastern African cuisines is widespread so far.. Côte d'Ivoire, is the second African palm oil producer after Nigeria with 300 000 tons produced in 2005 and 485.715 tons in 2015 [4].

Palm oil contained 50% saturated fatty acids (SFA), including 44% palmitic acid and 50% unsaturated fatty acids (USFA) [5]. Because of its high content of SFA (50%), palm oil has been always accused of being a potentially harmful to human health [6,7]. Furthermore, some epidemiological and clinical studies have related the increasing of the cardiovascular risk to the consumption of SFA [8,9]. Therefore, in order to reduce cardiovascular disease (CVD) [10,11] and obesity-related illnesses [12], the effects of a diet rich in SFA, have been the subject of several dietary guidelines. However, this composition in SFA gives to palm oil a particular characteristics that the other competing oils (rapeseed and soybean oils) do not have, that is to say its semi-solid consistency at room temperature with a specific melting temperature which swings between 33°C and 39°C. These previous characteristics give to the palm oil a better advantage over human health than its counterparts (rapeseed and soybeans) [13].

In addition, some authors [14] published have a meta-analysis of prospective studies showing that there is no relationship between SFA intake and the risk of coronary artery disease, stroke or cardiovascular disease. In the Ivory Coast, few research works have been carried out in on the same topic. Other authors [15] had shown the antioxidant role of crude palm oil in the lack of oxidative stress in an area deficient in selenium within the country. Furthermore, the study carried out [16], on 120 subjects suffering from ischemic heart disease, consuming palm oil during several weeks period did not report any disturbance of the lipid and lipoprotein parameters in these subjects. The consumption of palm oil in connection with human health is at the core area of several controversies. So in order to highlight the influence of the palm oil on the human health, we conducted this present study to provide an input on the effects of palm oil consumption on the lipid profile of the population of Jacqueville at the southern part of Côte d'Ivoire.

2. MATERIALS AND METHODS

2.1 Subjects, Criteria for Inclusion and Non-Inclusion of Palm Oil Consumption

This work is a cross-sectional, descriptive and analytical study aim carried out in the town of Jacqueville (Côte d'Ivoire) and in a locality of Jacqueville (Ahua), which started with a food survey during which 363 people had been identified in households. After this first phase, people aged under 18 and over 50, sick people, pregnant women and people who have recently migrated to the area were not included in the study. The second phase of the study was carried out with 83 volunteers out of 128 people of both sexes whose age was between 18 and 50 years old, apparently in good health, having the same eating habits, except for the amount of palm oil consumed per day (22.86%) of the study population. During this phase, the lipid parameters were determined.

According to nutritional recommendations, 15 to 35% of calories in the form of lipids must be provided by any diet per day while the average of the total metabolism for an average adult is 2500 Kcal per day [17]. Regarding oil consumption, the recommended intakes were calculated as previously described [16]. In the study area, the entire population consumed palm oil either in the refined form or in the raw form or both.

Therefore, based on the amount of Palm oil consumed per day our targeted population divided into two separated groups. Thereby, the first group involved 40 active people consuming 2 tablespoons of 15 ml of palm oil corresponding to 30 g of oil (controls subjects), providing 270 Kcal per day and per person, or 10.8% of the total daily energy. While the second group involved 43 others active people consuming on average 4 and a half tablespoons of 15 ml of palm oil corresponding to 67 g (consumers) providing 603 Kcal per day and per person, or 24.12% of total daily energy. In both group the data collection lasted at least 6 months period.

2.2 Survey

We conducted aprior food survey in the study area which showed that palm oil is an important component of the diet for this population. Furthermore during the present study, a survey sheets were completed by the interviewer for each surveyed subject.

2.3 Blood Sampling

We collected blood samples in the morning on individuals fasting for at least 12 hours lasted in the laboratory of the General Hospital of Jacqueville. Then we sampled blood from each individual by venipuncture at the elbow level. We collected that blood in 5 ml dry Vacutainers tubes which were centrifuged at 4000 rpm for 5 min period to obtains hortly later we the serum. Thereby we put in two separated micro-tubes the serum gathered from each individual. The aliquots of collected serum were stored by freezing at temperature under -20°C (temperature ≤ -20°C) until they getanalyzed.

2.4 Anthropometry

The body mass of all subjects who agreed to submit to the questionnaire was taken using an accurate brand electronic scale with an accuracy of 0.5 kg. Using a measuring rod, the size was measured. The body mass index was calculated using the following formula:

$$BMI\ (Kg.m^{-2}) = (Mass\ of\ the\ subject\ (Kg)) / (Size\ of\ the\ subject\ (m))^2$$

The BMI limits used were according to the official classification accepted by the World Health Organization): 16.5 - 18.5 for lean people, 18.5 - 24.9 for normal people, 25 - 29.9 for overweight people and 30 and more for obese people.

2.5 Measurement of Blood Arterial Pressure

We measured blood pressure as well as systolic and diastolic pressure at different periods of the study as the following: during the survey, between the survey and blood sampling and during blood sampling by using the digital model M6 COMFORT from the brand *OMRON*. In addition, we took the blood pressure from the subjects'left arm while sitting with a prior 15 minutes rest period.

2.6 Determination of Plasma Lipid Parameters

We dosed Total Cholesterol (CT) using Enzymatic method at final point to Cholesterol Oxidase [18] that of the Triglycerides (TG) with glycerol phosphate oxidase [19]. We dosed HDL-C using method Precipitation with Phosphotungstic acid method in presence of Magnesium ions [20]. The dose of LDL Cholesterol (C-LDL) was performed blocking lipoproteins other than LDL method [21]. Furthermore, only the cholesterol associated to LDL was dosed by Enzymatic Reaction. Finally, the Atherogenicity index (IA) was determined [22] method, where IA = CT / C- HDL.

2.7 Data Analysis

We used Student's t test to compare the means of control subjects versus palm oil consumers, where we considered the test to be significative at P ≤ 0.05. Then, the results showed different means calculated with its standard deviations. We performed data analysis using SPSS software (version 17).

3. RESULTS

3.1 Anthropometric Parameters

The sex ratio (men / women) is respectively 0.66 for within the group of control subjects and 0.43 within the group of palm oil consumers.

Furthermore, the analysis of the anthropometric results are presented in Table 1 shows that there is no significant difference in the mean age, mean weight, mean height and the in mean BMI between the two study groups. However, regarding the height (body size) our results show

a high significant difference within each group (P = 0.000). In addition, there is a strong significant difference (P = 0.001) concerning the BMI between men versus women within the group of palm oil consumers group. Also, there is a significant difference (P = 0.05) for the same parameter between men versus women within the group of control subjects. Finally there is a significant difference (P = 0.03) between the women of the controls and consumers of palm oil regarding age.

3.2 Plasma Lipid Parameters

3.2.1 Lipid parameters of all the subjects within of the study groups

The mean serum concentrations of all lipid parameters in the two study groups are normal (Table 2), except HDL Cholesterol which is lower than the normal values that swing between 0.4 g / L and 0.6 g / L for low consumers (0.33 ± 0.05 g / L) and medium consumers (0.32 ± 0.06 g / L). Furthermore, the comparison of the mean values of CT, HDL-C, LDL-C, TG and IA between the two study groups showed that the mean concentrations do not vary significantly ($P > 0.05$).

3.2.2 Lipid parameters by age class and by group of subjects

When taking into account the age classes, the comparison between the mean values of the lipid parameters for control subjects within 18 to 35 years old and 36 to 50 years old with palm oil consumers for the same age classes shows no significant difference ($P > 0.05$). In addition, the comparison of the serum concentrations of the lipid parameters of control subjects within18 to 35 years old and 36 to 50 years old with palm oil consumers for the same age classes shows, no significant difference ($P > 0.05$) (Table 3).

3.2.3 Lipid parameters by sex and by group of subjects

In both man and woman subjects, there is no significant difference between the two groups (control subject and palm oil consumer subjects)as well as within each group for the mean total Cholesterol, the HDL Cholesterol and the LDL Cholesterol (p>0.05). In addition, there is no significant difference for Triglyceridemia between the control women and those who consume palm oil (P =0.05) as shown in Table 4.

3.3 Measurement of Blood Pressure

Regarding blood pressure, our results show a that the two study groups have both low mean systolic and diastolic pressures which is about 11.38 ± 1.42 and 11.53 ± 1.48 and 7.23 ± 1.00 and 7.47 ± 0.98 respectively for the control subject and palm oil consumers. However, there is no statistical difference in the mean values of systolic and diastolic pressure for control subjects and palm oil consumers (Table 5).

4. DISCUSSION

The sex ratio of 0.43 and 0.66 respectively for consumers and controls is explained by the fact that in the study area, more women were encountered in households. This result is comparable to the study carried out on the serum lipid profile of nomadic adult Fulani in North Benin during which the sex ratios were 0.7 for the Peul group and 0.90 for the non-Peul group. In our study, this result could be justified by the fact that women were much more willing to participate in the study than men [23]. Analysis of the anthropometric parameters of the study population showed that the weight of palm oil consumers did not vary significantly compared to the controls. This result is comparable to that of Aké Aké et al [24] who showed that the consumption of palm oil by the young rural population of Grand-Alépé (Côte d'Ivoire) did not influence the weight of the subjects. In this study, palm oil consumers with an average BMI of 25.59 ± 3.72 kg / m^2 and controls with an average BMI of 25.57 ± 3.84, kg / m^2, were overweight. The BMI values obtained in this work are higher than those of Aké Aké et al [25] who obtained an average BMI of 22.02 ± 3.50 kg / m^2 for consumers and an average BMI of 22.16 ± 3.92 kg / m^2 for the controls, during a study concerning the effects of palm oil consumption on the nutritional status of a young rural population in Grand-Alépé (Côte d'Ivoire). This study reveals that both study groups were hypotensive with 11.38 / 7.23 and 11.53 / 7.47 as systolic and diastolic blood pressures for controls and consumers, respectively. This result is similar to that of Grynberg [26] who showed that oleic acid, a monounsaturated omega-9 fatty acid, has recently received substantial attention for its potential role in regulating blood pressure, because acid oleic being the main unsaturated fatty acid which constitutes up to 40% of the total fatty acid present in palm oil [27].

Table 1. Anthropometric data of the study groups

| Sex | Control subjects (30 g / day) | | P | Consumers (67 g /day and more) | | P | P | |
	Men	Women		Men	Women		Men	Women
Number of subjects	16	24		13	30			
Weight(Kg) m ± sd	73.25 ± 12	69.28 ± 11	0. 29	70.42 ± 10	71.71± 11	0.72	0.50	0.43
Age (year) m ± sd	33 ± 9	32 ± 8	0.71	35 ± 10	36 ± 70	0.42	0.71	0.03
Height(m) m ± sd	1.75 ± 0.07	1.61 ± 0.06	0.000	1.75 ± 0.07	1.63 ± 0.07	0.000	0.96	0.24
BMI (Kg/m^2) m ± sd	24.14 ± 4	26.53 ± 3	0.05	22.88 ± 3	26.76 ± 3	0.001	0.36	0.80

BMI: body mass index; m ± SD: mean ± standard deviation

Table 2. Values of the lipid parameters of the study groups

	Control subjects (30 g / day)	Consumers (67 g /day and more)	P
Number of subjects	40	43	
CT, g/L m ± sd	1.53 ± 0.32	1.43 ± 0.30	0.69
C-HDL, g/L m ± sd	0.33 ± 0.05	0.32 ± 0.06	0.12
C-LDL, g/L m ± sd	1.00 ± 0.26	0.99 ± 0.22	0.83
TG, g/L m ± sd	0.72 ± 0.17	0.67 ± 0.16	0.16
IA, m ± sd	4.68 ± 0.64	4.46 ± 0.75	0.15

CT: total cholesterol; HDL C: HDL cholesterol; LDL C: LDL cholesterol; TG: triglyceride; IA: atherogenicity index; m ± SD: mean ± standard deviation

Table 3. Mean values of lipid parameters by age group and by group of subjects

| Age group | Control subjects (30 g / day) | | P | Consumers (67 g /day and more) | | P | P | |
	18- 35	36- 50		18- 35	36- 50		18- 35	36- 50
Number of subjects	26	14		18	25			
CT, g/L m ± sd	1.57 ± 0.30	1.47 ± 0.34	0.38	1.45 ± 0.31	1.41 ± 0.30	0.65	0.23	0.55
C-HDL, g/L m ± sd	0.32 ± 0.60	0.33 ± 0.05	0.82	0.31 ± 0.07	0.32 ± 0.06	0.66	0.65	0.82
C-LDL, g/L m ± sd	0.99 ± 0.27	1.02 ± 0.24	0.73	0.93 ± 0.22	1.04 ± 0.22	0.14	0.43	0.86
TG, g/L m ± sd	0.75 ± 0.17	0.66 ± 0.14	0.09	0.69 ± 0.18	0.65 ± 0.15	0.53	0.23	0.91
IA, m ± sd	4.80 ± 0.52	4.47 ±0.79	0.12	4.62 ± 0.70	4.35 ± 0.78	0.24	0.34	0.64

CT: total cholesterol; HDL C: HDL cholesterol; LDL C: LDL cholesterol; TG: triglyceride; IA: atherogenicity index; m ± SD: mean ± standard deviation

Table 4. Mean values of lipid parameters by sex and by group of subjects

Sex	Control subjects (30 g / day)		P	Consumers (67 g /day and more)		P	P	
	Men	Women		Men	Women		Men	women
Number of subjects	**16**	**24**		**13**	**30**			
CT, g/L m ± sd	1.53 ± 0.35	1.53 ± 0.30	0.97	1.47 ± 0.38	1.41 ± 0.27	0.54	0.65	0.11
C-HDL, g/L m ± sd	0.32 ± 0.05	0.33 ± 0.06	0.62	0.33 ± 0.07	0.32 ± 0.06	0.55	0.69	0.45
C-LDL, g/L m ± sd	1.03 ± 0.25	0.99 ± 0.26	0.63	1.06 ± 0.27	0.96 ± 0.20	0.22	0.77	0.72
TG, g/L m ± sd	0.69 ± 0.15	0.75 ± 0.18	0.27	0.69 ± 0.21	0.66 ± 0.14	0.55	0.90	0.05
IA m ± sd	4.72 ± 0.56	4.66 ± 0.69	0.77	4.44 ± 0.74	4.47 ± 0.77	0.88	0.25	0.36

CT: total cholesterol; HDL C: HDL cholesterol; LDL C: LDL cholesterol; TG: triglyceride; IA: atherogenicity index; m ± SD: mean ± standard deviation

Table 5. Mean blood pressure values for the two groups of subjects studied

	Control subjects (30g/ day)	Palm oil consumers (67g/day and more)	*P*
Number of subjects	40	43	
Systolic blood pressure			
m ± sd	11.38 ±1.42	11.53 ± 1.48	0.62
Diastolic blood pressure			
m ± sd	7.23 ± 1.00	7.47 ± 0.98	0.27

m ± SD: mean ± standard deviation

Indeed, it has been suggested that the mechanism of the hypotensive effect of oleic acid is attributable to the increase in the concentration of oleic acid in the lipid membranes which regulates the localization, the activity and the expression of 'important signaling molecules in the adrenergic receptor pathway, and improves the production of vasodilator stimuli while limiting vasoconstriction pathways[28].

The consumption of palm oil in this study did not significantly influence the concentration of total cholesterol (1.43 ± 0.30 g / L) and the concentration of LDL cholesterol (0.99 g / L) for the consumers although lower than witness values. These results could be used as evidence to confirm that the consumption of palm oil has no influence on the risk of cardiovascular disease among consumers. This thesis was consolidated by the values of the atherogenicity index which were 4.46 ± 0.75 for consumers and 4.68 ± 0.64 for witnesses and would be in favor of the non atherogenicity of palm oil unlike the work from Edem [5], because of the high content of palmitic acid (AGS) in palm oil, which represents 44% of total fat. Because according to some studies, saturated fats increase the concentrations of total and LDL cholesterol [29] and the risk of CHD events [30] when replacing polyunsaturated fats. The result of our study is similar to that reported by Lecerf [31], showing that the consumption of palm oil induces a stable lipid profile compared to partially hydrogenated vegetable fats.

In addition, in studies comparing palm oil to soybean oil (a vegetable oil with more PUFA and less AGS) [32,33], with olive oil (rich in oleic acid, an AGMI) [32,34], with sunflower oil (rich in oleic acid and PUFA)) [32,33] and canola oil (rich in MUFA)) [32,35], no substantial difference in the serum lipid profile was observed. In some cases, changes in the cholesterol fractions, not affecting the CT / C-HDL or C-LDL / C-HDL ratios, have been recorded. Furthermore, Siri-Tarino et al. [14], published a meta-analysis of prospective studies showing no relationship between intake of SGA and risk of coronary artery disease, stroke or cardiovascular disease. de Souza et al.

[36], confirmed this hypothesis of absence of relation after a review of the literature and a meta-analysis. Among these studies, the Nurses 'Health Study showed only a weak association between AGS (lauric and stearic) and cardiovascular risk but no association with AGS (palmitic and butyric) [37]. On the contrary, two recent Japanese studies Yamagishi et al. [38], have shown a protective effect of AGS on the risk of stroke with a very strong reduction of this risk for the highest consumption, the benefit being observed from the threshold 20 g / d AGS [39]. On the other hand in our work, the average values of HDL cholesterol obtained are lower than the reference values, 0.33 ± 0.05 g / L for the controls and 0.32 ± 0.06 g / L for the consumers. These values do not show a significant difference between the two study groups. These results are lower than those reported by Aké Aké et al. [25], who obtained 0.43 ± 0.19 g / L for the controls and 0.42 ± 0.15 g / L for the consumers. This low HDL cholesterol level is believed to be linked to another factor different from palm oil consumption that was not taken into account in this study.

4. CONCLUSION

The present study described the lipid profile and the nutritional status of an active population consuming palm oil divided into two groups, during which the consumption of palm oil did not affect the average BMI , LDL-C, CT and TG, there is no significant difference in all serum lipid parameters between the two groups of subjects. Furthermore, it was found that all the lipid parameters studied had a normal value both in the controls and in the consumers, except for HDL-C for which we obtained values lower than normal, 0.33 ± 0.05 g / L and 0.32 ± 0.06 g / L respectively for witnesses and consumers.

ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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