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Effects of palm oil consumption on lipid and lipoprotein profiles in a group of hypertensive patients at the Abidjan heart institute

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Abstract

Aim: To study the changes in lipid and lipoprotein parameters in a group of hypertensive patients, consuming palm oil or not, at the Abidjan Heart Institute.

Methods: We recruited 196 hypertensive patients, which were divided into two group's consumers and non-consumers of palm oil. We analyzed total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol and atherogenic index.

Results: Participants' mean age was 57.13 years. Among palm oil consumers, 56.7% had normal cholesterol levels, while 30.8% had high cholesterol levels. In non-palm oil users, cholesterolemia was normal in 56.5% and elevated in 27.2%. Similarly, serum values of triglycerides, HDL cholesterol, LDL cholesterol and atherogenic index, also showed no significant difference between palm oil consumers and non-consumers.

Conclusion: The consumption of palm oil does not significantly influence the lipid and lipoprotein parameters and therefore, has no effect on increasing blood pressure.

Keywords: palm oil, cholesterol, triglyceride, lipoprotein, atherogenicity index, hypertension

1. Introduction

Cardiovascular diseases accounted for most non-communicable disease deaths (17.5 million NCD deaths) and are globally the leading cause of death [1]. Their prevalence is incessantly progressing in both developed and developing countries [2, 3]. High blood pressure is the most common cardiovascular disease and is a major public health problem for societies in socioeconomic and epidemiological transition [4]. Globally, more than a quarter (26.4%) of the adult population is hypertensive and several studies shown the increasing prevalence of high blood pressure [5-8]. In France, 40% of people aged 65 and 90% of those aged 85 are affected by this pathology [9]. High blood pressure prevalence in a population-based cohort in Switzerland was found in 34.9% of subjects, 49.1% of whom were unaware of this condition [5]. Prevalence of self-reported high blood pressure among adults living in Brazilian state capitals and the federal district was 24.1% [6]. This trend is increasing, especially in sub-Saharan Africa, where about eighty million patients had hypertension, and according to the epidemiological projections, they will be fifty million in 2025 [4, 10]. In Côte d'Ivoire, the prevalence of hypertension is estimated at 33.4%, and represents 75% of consultations at the Abidjan Heart Institute [11].

Obesity, high cholesterol, hypertriglyceridemia are mainly considered as major risk factors for cardiovascular disease and occurrence of elevated blood pressure [1, 4, 12]. In addition, it is well known that hypertension and hypercholesterolemia are inter-related and mutually potentiating cardiovascular risk factors, that, when occurring together, strongly accelerate atherosclerosis and significantly increase cardiovascular risk [3, 13-15]. There are hereditary hypercholesterolemias, other side to a disease or nutritional origin in an excessive intake of saturated fat, cholesterol, calories [7-9]. Among oil, palm oil is one of the most important sources of food lipids and is the most widely consumed oil in the world, with nutritional and beneficial properties for health [16-20]. But this oil is alleged to be atherogenic due to its high content of saturated fatty acids, namely palmitic acids [21-22].

We have previously shown that some patients with hypertension [23] did not consume palm oil because it was recommended to them by members of the medical and paramedical personnel, under the pretext that this consumption exposes these patients to cardiovascular complications and other chronic diseases [24]. Although palm oil is known to exercise beneficial effects on human health [19, 20, 25], it is subject of controversies. Thus, we previously studied impact of its consumption on variations in lipid and lipoprotein profiles of healthy young Ivorian subjects living in rural areas [26]. But no work has been done on lipid and lipoprotein profile in hypertensive patients, whether or not they use palm oil in our country, taking into account the high prevalence of hypercholesterolemia in hypertensive patients [3, 13-15] which increases cardiovascular risk factors. Therefore, this work was undertaken to study the changes in lipid and lipoprotein parameters in a group of hypertensive patients, consuming palm oil or not, at the Abidjan Heart Institute.

2. Material and methods

2.1 Patients

Hypertension was defined as systolic blood pressure 140 mm Hg and/or diastolic BP 90 mm Hg or use of antihypertensive medication. A total of 196 hypertensive patients were systematically sampled. These patients attend both the consultation service and the laboratory of the Abidjan Heart Institute, according to well-defined criteria. These are adult patients (≥ 18 years old) of both sexes, known hypertensive patients with or without palm oil consuming. There were 104 patients who consumed palm oil, while 92 patients did not consume. Among palm oil consumers, there were 20 (19.2%) who consumed in both

forms, i.e., crude, and refined, and 84 (80.8%) consumed only refined form of palm oil. Patients who did not consume palm oil, used others oil in their diet. Patients who refused the samples were not selected. A researcher-administered questionnaire collected information on socio-demography, presence of high blood pressure (BP), family history of hypercholesterolemia. Other measurements included: blood pressure, weight, height, abdominal circumference.

2.2 Methods

This prospective cross-sectional descriptive and analytical study lasted four months. The biochemical parameters analyzed were total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol and total cholesterol / HDL or atherogenic index. The assays were performed at Biochemistry laboratory of Treichville Teaching Hospital, on automated "Random Cobas Integra 400" (Roche Diagnostics), according to conventional enzymatic methods. The data collection was conducted on a survey sheet.

2.3 Ethical approval and Informed consent

The Protocol was approved by institutional Ethics committee. The written informed consent of each patient was obtained.

2.4 Statistical analysis

The statistical analysis performed using SPSS. The results are shown as mean \pm SD (Standard Deviation) and median (range). The data was analyzed using the Fisher, and chi-squared tests. The p value of <0.05 was denoted as statistically significant.

3. Results

Table 1: Changes in lipid and lipoprotein parameters according to consumption or not of palm oil

Lipid and lipoprotein parameters		Palm oil consumers		Not consumers of palm oil		P
		Proportion	Percentage	Proportion	Percentage	
Total cholesterol (g/l)	<1.5	13	12.5	15	16.3	0.7
	1.5–2.2	59	56.7	52	56.5	
	> 2.2	32	30.8	25	27.2	
Triglycerides (g/l)	< 0.4	1	1.0	1	1.1	0.69
	0.4 g/l – 1.4	83	83.8	72	79.1	
	> 1.4	15	15.2	18	19.8	
HDL cholesterol (g/l)	< 0.4	19	18.4	14	15.2	0.55
	≥ 0.4	84	81.6	78	84.8	
LDL cholesterol (g/l)	< 1.7	79	79.0	69	75.8	0.6
	≥ 1.7	21	21	22	24.2	

Among palm oil consumers, 56.7% had normal cholesterol levels, while 30.8% had high cholesterol levels. In non-palm oil users, cholesterolemia was normal in 56.5% and elevated in 27.2%. In patients consuming palm oil, 83.8% had a normal triglyceride level compared to 15.2% with triglyceride level increased. In non-users, triglyceride levels

were normal in 79.1% and increased in 19.8%. The difference was not significant. Serum HDL cholesterol levels were normal in 81.6% of palm oil consumers. In non-consumers, 84.8% had normal HDL cholesterol levels. The difference was not significant between the two groups.

Table 2: Mean changes in lipid and lipoprotein parameters depending on palm oil consumption or not

Lipid and lipoprotein parameters		Palm oil consumers	Non consumers of palm oil	P
		Total cholesterol (g/l)	2.02 \pm 0.54	
Triglycerides (g/l)	1.17 \pm 1.52	1.19 \pm 0.93		
Cholesterol HDL (g/l)	0.48 \pm 0.14	0.48 \pm 0.17		
Cholesterol LDL (g/l)	1.32 \pm 0.48	1.28 \pm 0.5		
TC/HDL ratio	4.6 \pm 2.2	4.3 \pm 1.61		

The mean changes of various lipid and lipoprotein parameters studied showed that differences observed in the

groups of palm oil consumers and non-consumers were not significant.

Table 3: Changes in serum lipid and lipoprotein parameters according to consumption pattern of palm oil

Lipid and lipoprotein parameters	Forms of consumption					P
		Refined		Both forms		
		Proportion	Percentage	Proportion	Percentage	
Total cholesterol (g/l)	<1.5	9	10.7	4	20.0	0.49
	1.5 – 2.2	48	57.1	11	55.0	
	> 2.2	27	32.1	5	25.0	
Triglycerides (g/l)	< 0.4	1	1.2	0	0.0	0.29
	0.4 – 1.4	12.5	86.2	14	73.7	
	> 1.4	10	12.5	5	26.3	
HDL Cholesterol (g/l)	< 0.4	12	14.5	7	35.0	0.051
	≥ 0.4	71	85.5	13	65.0	
LDL Cholesterol (g/l)	< 1.7	63	78.8	16	80.0	0.58
	≥ 1.7	17	21.2	4	20.0	

Cholesterol levels were 57.1% for refined palm oil consumers and 55% for consumers of both forms. Patients consuming only refined form of palm oil had a normal triglyceride level of 86.2% and high in 12.5%; while in those who consumed both forms of oil, 73.7% had normal triglycerides and was elevated in 26.3% of them. The difference was not significant. Serum HDL cholesterol levels were normal in 85.5% of consumers of the palm oil refined form and lowered in 14.5% of them. Among consumers of both forms of oil, 65% had normal serum HDL cholesterol level and 35% a high rate. In patients consuming only the refined form of palm oil, 78.8% had normal serum LDL cholesterol level, while 21.2% were elevated. In consumer patients of both forms, 80% had normal LDL levels, while 20% was high.

Table 4: Variation of atherogenicity index (TC / HDL ratio) according to the consumption or not of palm oil

	Atherogenicity index			P
		Normale	High	
Palm oil consumers	Proportion	62	38	0.95
	Percentage	62.00	38	
Not consumers of palm oil	Proportion	56	35	
	Percentage	61.5	38.5	

Among palm oil consumers, 62% had a normal atherogenicity index. The proportion with normal atherogenicity index at the non-consumer level was about the same (61.5%). There was no significant difference between the two groups.

4. Discussion

4.1 Age, sex, and duration of hypertension

The patients were mostly adults (55.1%) with an average age of 57.13 years. The female sex was predominant, with a ratio sex of 0.75 in agreement with those of Youmbissi *et al.* [27] who reported an average age of 56 years for men and 55 years for women in a population of hypertensive patients in a study on lipid profile in hypertensive to Cameroon. This age is the one from which metabolic diseases such as diabetes and chronic diseases like arterial hypertension usually occur. Hypertension had been changing for less than 5 years in most patients, who were regularly monitored for their pathology at the Abidjan Heart Institute. Patients with mild hypertension (Grade 1) accounted for the largest number (34.9%), followed by those with a high normal-grade hypertension (31.8%), while Grade 2 patients

accounted for 26.7%. Youmbissi *et al.* [27] had also found 26.11% of moderate hypertension, consistent with our results.

4.2 Consumption or not of palm oil and form of consumption

Patients who consumed palm oil in their diet were significantly more numerous (53.1%) than those not consuming (46.9%). These results are contrary to those of previous work [23], where we had reported 96.25% of consumers. The current palm oil consumption could be explained by the fact that this oil is the main oil produced in West Africa regions, and moreover, Côte d'Ivoire is the second producers [28] of this oil in Africa. In addition, palm oil is present, not only in most urban commercial areas, but also in markets, in the countryside and at affordable prices, which would favor its choice by people. Regarding palm oil form of consumption, most consumer patients (80.8%) preferred it in refined form, while only 19.2% used the crude and refined forms of the oil for their different meal. We didn't find patients who consumed exclusively crude red palm oil, while this form is rich in carotenoids, vitamin E and other important phytonutrients [18, 20, 25].

4.3 Variations in lipid and lipoprotein parameters in patients with and without palm oil

Hypercholesterolemia was defined according to cardiovascular risk and LDL-cholesterol levels or use of lipid-lowering drugs [9, 12]. Most of patients consuming palm oil had a total normal cholesterol, without any significant difference with the values in non-consumer's patients (Table 1). Sun *et al.* [29] reported similar proportions. It is well known that palm oil is a vegetable oil that does not contain cholesterol [18, 20]. In addition, cholesterol is produced endogenously in 2/3 cases from acetyl coenzyme A, the remaining 1/3 comes from food, including animal fat [30]. Different mean values of lipid and lipoprotein parameters are normal, without no significant difference between palm oil consumers and non-consumers (Table 2).

Most of patients consuming palm oil or not, triglyceride levels were normal, with no significant difference between the two groups. Regarding the palm oil form of consumption, total cholesterol and serum triglyceride concentrations were substantially the same in patients who consumed exclusively refined form, likewise patients consuming both forms, without significant difference (Table 3). Most of patients had normal total cholesterol and

triglyceride values, and these results were close to that reported by Dauqan *et al.* [31]. It is well known that trans fatty acids increase total cholesterol and serum triglyceride content, while palm oil does not contain trans fatty acids, and therefore, cannot increase these parameters levels [17, 20]. The consumption of palm oil or not didn't significantly influence the HDL cholesterol level, just like the form of consumption (Tables 2 and 4). Boon *et al.* [16] had shown that long-term use of palm oil in its various forms raised HDL cholesterol levels in hypertensive rats. Mukherjee [17] and Sundram [18] also reported the beneficial effects of palm oil consumption on the lipid profile of rats, particularly on HDL cholesterol level elevation. Thus, the consumption of palm oil has a protective effect against cardiovascular diseases, because of increasing the HDL cholesterol level, thus fighting against atherosclerosis [16-18].

Serum LDL cholesterol level was normal although in patients consuming palm oil and non-users. Thus, the consumption or not of palm oil does not significantly influence serum LDL cholesterol levels. Palm oil is rich in carotenoids, vitamin E (tocopherols and tocotrienols), which are known to have major antioxidant properties [19, 20]. Indeed, Amr and Kamsiah demonstrated the significant effects of palm oil consumption on lipid profile in mice [32] and the beneficial effects on the heart in rats [33]. The combined effect of antioxidant properties of carotenoids, tocopherols, tocotrienols and the 50% unsaturated fatty acids contained in palm oil gives it a high oxidative stability compared to other vegetable oils [19, 20, 30]. Studies have shown that diet rich in saturated fatty acids (AGS) increases LDL cholesterol [19], while the presence of antioxidants, such as carotenoids has a well-known cardioprotective effect. In fact, the higher LDL cholesterol level, the higher the risk of atherosclerosis and higher the HDL cholesterol level, the lower the risk of cardiovascular disease. Concerning the benefits linked to the consumption of palm oil, this work agrees with that of Sun *et al.* [29], who had reported that palm olein had no recognizably different effects on body fatness or blood lipids in a healthy Chinese population. Edem and Mukherjee also showed a reduction in serum LDL cholesterol levels [17, 20]. Thus, the long-term consumption of palm oil, because of their antioxidant properties, lowers LDL cholesterol levels as proved in other studies [17, 20, 30].

4.4 Changes in atherogenicity index

The atherogenicity index was normal (TC / HDL) in both palm oil consumers and non-consumers, with an insignificant difference (62 and 61.5% respectively). These results agree with those of Boon [16], who found that CT / HDL index was low in rats supplemented with palm oil. This may suggest the role of palm oil in the significant decline in atherogenicity index from these animals. Edem and Fife [20, 30] had previously shown the important role of palm oil in reducing atherogenicity index. Thus, palm oil could help to reduce the risk of developing hypertension-associated cardiovascular disease by improving lipid and lipoprotein profile of hypertensive patients [34]. We can postulate that normal consumption of palm oil has no effect on increasing blood pressure; it is rather the intake of repeatedly heated palm oil that causes an increase in blood pressure because oxidization of dietary cooking oil increases the risk of cardiovascular diseases such as hypertension by increasing the formation oxidative oxygen radicals [33, 35].

5. Conclusion

The consumption of palm oil does not significantly influence the lipid and lipoprotein parameters and therefore, has no effect on increasing blood pressure. The population should be made aware of the benefits of its consumption, due to its high vitamin E content (tocopherols and tocotrienols), β -carotenes, which could contribute to improve cardiovascular risks in hypertensive patients.

6. Author's contribution

All authors contributed to the drafting of the manuscript. M.A.A., B-N.B. contributed to the writing of the manuscript. C-C.M., K.K.G. and G-G-A.C, performed the bibliographic data sections. Y-A. B., E.Y.C., I.C. and N.A.R. contributed to the selection of patients. M.A.A., C-C-M. and N.A.R. approved the final document.

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