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Research Article

Palm Oil Consumption and Serum Lipid and Lipoprotein Profiles in Patients with Type 2 Diabetes in Abidjan

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Abstract

Diabetes is a major public health problem, and dietary fat intake plays a significant role in its incidence and progression. The impact of palm oil consumption on lipid and lipoprotein profiles remains controversial, particularly among diabetic patients. This study aimed to assess the influence of palm oil consumption on serum lipid and lipoprotein profiles in patients with type 2 diabetes (T2D) in Abidjan. A cross-sectional study including diabetic patients categorised according to the frequency and form of palm oil consumption was conducted in which total cholesterol (TC), triglycerides (TG), HDL cholesterol (HDL-c), LDL cholesterol (LDL-c) and the atherogenic index were measured and compared between the different groups. The chi-squared test was used with a significance level of p value <0.05. No statistically significant differences were observed between frequent and occasional patient consumers in terms of total cholesterol (p=0.799), triglycerides (p=0.579), HDL-cholesterol (p=0.840), LDL-cholesterol (p=0.116) and atherogenic index (p=0.588). Similarly, the form of palm oil consumed did not significantly influence lipid and lipoprotein profiles. Palm oil consumption, regardless of frequency or form, does not significantly alter the lipid and lipoprotein profile of type 2 diabetic patients. These findings suggest that palm oil intake, within habitual dietary patterns, may not be a primary determinant of dyslipidemia in this population.

Keywords

Type 2 Diabetes, Palm Oil, Total Cholesterol, Triglycerides, HDL Cholesterol, LDL Cholesterol, Atherogenic Index

1. Introduction

Type 2 diabetes (T2D) represents a major public health challenge, affecting an estimated 537 million people in 2021, with an alarming projection of 783 millions by 2045 [1]. This chronic disease is characterised by metabolic imbalances, particularly

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in carbohydrates, lipids and lipoproteins, and is frequently associated with severe cardiovascular complications. Among these imbalances, diabetic dyslipidaemia, defined as an increase in triglycerides, a decrease in HDL cholesterol and an increase in small LDL particles [2], is a key factor in cardiovascular risk in these patients. Unbalanced dietary habits, especially excessive fat and sugar intake, play a crucial role in the onset of dyslipidemia [3].

Palm oil, a staple dietary fat in tropical countries such as Côte d'Ivoire, has become the focus of increasing research interest because of its saturated fatty acid content. This oil has been the subject of numerous experimental and human studies worldwide [4-9]. While some studies highlight its impact on the lipid profile, attributed to its richness in saturated fatty acids, particularly palmitic acid [10, 11], while others have demonstrated its health benefits [7, 12-15], particularly due to the antioxidant properties of red palm oil. Despite this work, its use in the diet of patients with chronic diseases remains controversial, as some practitioners advise against its use [16]. In a previous study, we found no significant association between palm oil consumption and hypercholesterolemia in Ivorian subjects [17]. Experimental studies such as Albrahim et al. [8] demonstrated the hypocholesterolemic effects of palm oil in rats with hypercholesterolaemia. Kouakou et al. [18] also studied the effects of palm oil enriched diet on lipid profile and glycemia in Wistar rats in Côte d'Ivoire. However, the impact of palm oil consumption on lipid and lipoprotein metabolism in type 2 diabetic patients remains limited and inconsistent. In West African regions, where palm oil is staple oil, it would be wise to evaluate its impact on lipid and lipoprotein parameters in T2D patients in Abidjan.

2. Materiel and Methods

2.1. Study Population and Sampling

This descriptive and analytical cross-sectional study was conducted over nine months. Participants were T2D patients attending the Endocrinology-Diabetology Unit at the University Hospital. They had controlled blood glucose levels (0.70–1.20 g/L) and glycated haemoglobin levels ≤ 7%. Patients were divided into two groups: palm oil consumers and non-consumers. Patients were aged 30 years and older, of both sexes, and provided verbal and written informed consent. This study was approved by the Scientific Medical Department of the Yopougon University Hospital. The sample size was calculated using Schwartz's formula (1996) [19]. A total of 160 T2D patients with eligible criteria were selected.

2.2. Operational Definition

In the consumer group, the average intake was self-reported and estimated at 150-300 ml of palm oil per day. Frequent consumption was defined as three to four times per week, while occasional consumption corresponded to one to two times per week. Palm oil forms included red palm oil (crude), refined palm oil, both forms combined.

Non-consumers were individuals who ceased using palm oil after medical recommendations or replaced it with other vegetable oils, including olive, sunflower, soybean, or groundnut oil.

2.3. Samples Collection and Biochemical Analysis

Fasting blood samples (10-12 hours) were drawn from the antecubital vein using 5 mL dry tubes, centrifuged at 3000 rpm for 5 minutes. Serum samples were aliquoted and stored at -20°C until analysis. Lipid and lipoprotein parameters were measured using enzymatic methods on a Cobas Integra 400 analyzer (Roche Diagnostics). LDL cholesterol (LDL-c) was calculated using the Friedewald formula. Atherogenicity index was calculated as the ratio of total cholesterol to HDL cholesterol. The reference values for lipid and lipoprotein parameters were total cholesterol < 6.20 mmol/L, LDL-c < 4.12 mmol/L, HDL-c > 1.04 mmol/L, triglycerides < 2.26 mmol/L and a normal atherogenicity index < 5 (Yapo et al., 1990) [20].

2.4. Ethical Considerations and Confidentiality

The study was approved by the Ivorian National Ethics and Research Committee for Clinical Research (N/Ref: 143/MSHP/CNERkp of 18 January 2018).

2.5. Data Analysis and Statistical Tests

Data were collected using a questionnaire. Lipid and lipoprotein parameters were analysed as categorical variables (normal vs. abnormal). Comparison of proportions was performed using the chi-squared test with a significance level < 0.05.

3. Results

Table 1 concerns distribution of T2D patients according to age range, duration of diabetes, and palm oil consumption habits. The average age was 57.10 ± 11.32 years and the majority of participants were aged over 50 (75.6%). Among them, 76.9% reported consuming palm oil, with a preference for both refined and crude forms (65.1%).

Table 1. *Epidemiological characteristics and consumption practices.*

Epidemiologicals characteristics		**N=160**	**%**
Age range (years)	<40	12	7.5
	[40-50]	27	16.9
	[50-60]	53	33.1
	≥60	68	42.5
Duration of diabetes (years)	<5	85	53.1
	[5-10]	32	20.0
	[10-15]	17	10.6
	≥15	26	16.3
Palm oil consumption	Yes	123	76.9
	No	37	23.1
*Form of consumption	Crude	09	7.3
	Refined	34	27.6
	Both forms	80	65.1

n: numbers of patients; percentages (%). *The form of consumption variable applies only to participants who reported using palm oil.

A majority of patients with type 2 diabetes had normal levels of total cholesterol (62.5%), triglycerides (80.6%) and a normal TC/HDL ratio (73.5%). Only 45.5% of participants had normal HDL cholesterol levels, while LDL cholesterol was normal in only 46.90% (Figure 1).

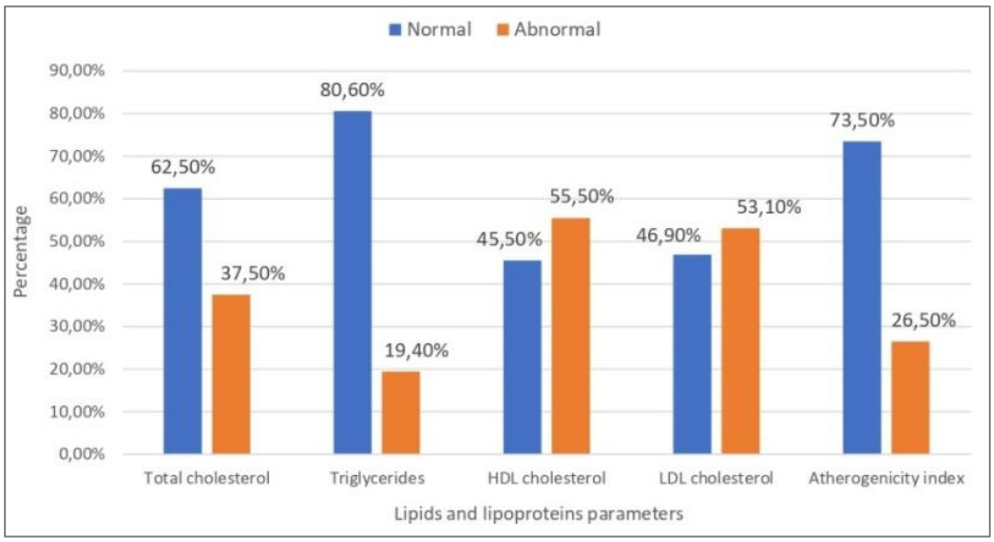

Figure 1. *Lipid and lipoprotein profile among all patients with type 2 diabetes.*

Cholesterol levels were relatively similar in the two groups, normal among palm oil consumers (56.8%) and non-consumers (68.4%), with no significant difference (p=0.137) (Table 2).

Table 2. *Comparison of lipid and lipoprotein parameters between palm oil consumers and non-consumers among patients with type 2 diabetes.*

Lipid and lipoprotein parameters		Consumption of palm oil		
		Yes (n; %)	No (n; %)	p-value
Total cholesterol	Normal	46 (56.8)	54 (68.4)	0.137
	High	35 (43.2)	25 (31.6)	
Triglycerides	Normal	64 (79)	65 (82.3)	0.601
	High	17 (21)	14 (17.7)	
HDL-c	Normal	33 (40.8)	35 (44.3)	0.649
	Low	48 (59.2)	44 (55.7)	
LDL-c	Normal	29 (35.8)	30 (38)	0.776
	High	52 (64.2)	49 (62)	
Atherogenic index	Normal	52 (64.2)	60 (75.9)	0.105
	High	29 (35.8)	19 (24.1)	

n: numbers; %: percentages, p-values (≤ 0.05) is statistically significant. HDL-c: high-density lipoprotein cholesterol; LDL-c: low-density lipoprotein cholesterol.

The form of palm oil consumed, had no influence on the lipid and lipoprotein parameters studied. Triglycerides levels were normal in 67.3% of patients consuming both types of palm oil, followed by those consuming only refined oil (25.5%) and crude oil (7.1%), with no statistically significant differences observed (p = 0.547) (Table 3). The proportions of normal and low HDL varied in the same direction, regardless of the type of oil consumed (p = 0.630). The frequency of palm oil consumption frequent or occasional had no significant effect on the lipid and lipoprotein parameters studied (p > 0.05) (Table 4).

Table 3. *Lipid and lipoprotein parameters according to the form of palm oil consumption among type 2 diabetic (T2D) patients (n = 123).*

Lipid and lipoprotein parameters		Form of palm oil consumption			
		Crude oil (n; %)	Refined oil (n; %)	Both forms (n; %)	p-value
Total cholesterol	Normal	05 (06.7)	23 (30.6)	47 (62.7)	0.633
	High	04 (08.3)	11 (22.9)	33 (68.7)	
Triglycerides	Normal	05 (07.1)	25 (25.5)	66 (67.3)	0.547
	High	02 (08.0)	09 (36)	14 (56.0)	
HDL cholesterol	Normal	04 (05.5)	21 (28.8)	48 (65.8)	0.630
	Low	05 (10)	13 (26)	48 (64.0)	
LDL cholesterol	Normal	04 (09.5)	15 (37.5)	23 (54.8)	0.227
	High	05 (06.2)	19 (23.5)	57 (70.4)	
Atherogenic index	Normal	08 (09.4)	24 (28.2)	53 (62.4)	0.370
	High	01 (02.6)	10 (26.3)	27 (71.1)	

Both forms: crude palm oil and refined oil

Table 4. *Lipid and lipoprotein parameters according to the frequency of palm oil consumption among type 2 diabetic (T2D) patients (n = 123).*

Lipid and lipoprotein parameters		Frequency of palm oil consumption				p-value
		Frequent		Occasional		
		n=53	%	n=70	%	
Total cholesterol	Normal	33	62.3	42	60.0	0.799
	High	20	37.7	28	40.0	
Triglycerides	Normal	41	77.4	57	81.4	0.579
	High	12	22.6	13	18.6	
HDL cholesterol	Normal	32	60.4	41	58.6	0.840
	Low	21	39.6	29	41.4	
LDL cholesterol	Normal	14	26.4	28	40.0	0.116
	High	39	73.6	42	60.0	
Atherogenic index	Normal	38	71.7	47	67.1	0.588
	High	15	28.3	23	32.9	

4. Discussion

The average age of participants was 57.1 years (range: 35 to 94 years), is in line with epidemiological data indicating that type 2 diabetes is more common at an advanced age. Ageing is generally associated with decreased insulin sensitivity and increased metabolic risk factors, promoting the onset of this pathology. Furthermore, the majority of patients were women (71.3%), with a sex ratio of 0.40. These observations were in agreement with the results of Arambewela et al. [21], who reported a mean age of 58 years and a female proportion of 72.7%. Palm oil consumption was high, with the majority of patients (65.1%) using both crude and refined forms. This high prevalence can be explained by the fact that palm oil is an essential part of the Ivorian diet, as Cote d'Ivoire is the second-largest producer of palm oil in Africa after Nigeria [22].

4.1. Palm Oil Consumption, Lipid and Lipoprotein Profile

Diabetes is a well-established risk factor for cardiovascular diseases (CVD) [23]. Furthermore, dietary fat intake has been implicated in the incidence of CVD and diabetes [10, 24]. In this context, our study explored whether palm oil consumption influences lipid and lipoprotein profiles among individuals with type 2 diabetes. Our findings indicate that palm oil consumption was not associated with significant alterations in total cholesterol levels. These observations were consistent with those of Kouakou et al. [18], who also reported that palm oil consumption had no significant impact on the overall lipid profile. Berkoh et al. [25] concluded that tropical vegetable oils such as palm oil did not alter the lipid and lipoprotein profile in type 2 diabetic subjects.

Similarly, triglyceride levels did not differ significantly between consumers and non-consumers ($p = 0.601$). These results are in line with other studies that showed palm oil consumption may reduce or have no impact on blood lipid levels, including triglycerides [26-28].

Low HDL-cholesterol levels were prevalent in both groups without a statistically significant difference, possibly reflecting a typical diabetic dyslipidaemia pattern in this population [2, 29]. Previous studies have shown that, compared to other vegetable oils rich in trans fats, palm oil was associated with higher HDL-cholesterol concentrations [18, 30].

Elevated LDL-cholesterol was common among participants, regardless of palm oil consumption status (64.2% of consumers vs. 62% of non-consumers, $p = 0.776$). Sun et al reported that palm oil consumption increased LDL cholesterol [30]. This results can be explained by factors such as the dietary fat types intake between West African and Asian populations, genetic backgrounds. In contrast somes experimentals studies demonstrated a reduction in total cholesterol (TC), LDL-c and HDL-c in rats fed palm oil [8, 31]. These findings suggest that palm oil may exert hypocholesterolemic effects, potentially attributable to its high tocotrienol content. Tocotrienols possess potent antioxidant properties and have been shown to confer protective effects against inflammation, and lipid peroxidation [4, 13, 32].

The atherogenicity index was predominantly normal in both

group with no significant difference observed. The presence of bioactive compounds in palm oil, including tocotrienols and phenolic antioxidants, may contribute to its reported cardioprotective properties [4, 7], consistent with findings by Ajiboye et al. [33].

4.2. Form and Frequency of Consumption

No significant differences in lipid or lipoprotein parameters were observed according to the form of palm oil consumed (crude, refined, or both). This supports experimental data suggesting that red palm oil may exert antioxidant-mediated lipid-modulating effects, largely attributed to its tocotrienol and phenolic content [4, 34-35]. Moreover, triglyceride levels remained largely within the normal range among patients consuming both forms (crude and refined palm oil), consistent with previous observations in patients with ischaemic heart disease [36].

The frequency of palm oil consumption did not significantly influence lipid or lipoprotein profiles. In contrast to reports suggesting that frequent palm oil intake may impair lipid profile [20, 37], our study showed a comparable level of total cholesterol, triglycerides, HDL-c, LDL-c, and atherogenic index to those consuming it occasionally. This demonstrates that palm oil, when consumed as part of a balanced diet, palm oil may not constitute a major cardiovascular risk factor for populations that use it [14].

5. Conclusion

Palm oil consumption did not significantly influence the lipid and lipoprotein profiles of patients with type 2 diabetes in this study. Factors such as lifestyle, comorbidities, genetic predisposition, and the overall management of diabetes may play a more important role in lipid and lipoprotein disturbances than simple consumption of palm oil. Further longitudinal and interventional studies are needed to clarify the long-term biochemical effects of palm oil within diabetic diets.

Abbreviations

TC	Total Cholesterol
LDL	Low Density Lipoprotein
HDL	High Density Lipoprotein
T2D	Type 2 Diabetes

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Data Availability Statement

The data supporting the outcome of this research work has been reported in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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