



Original Research Article

Incorporation and distribution of crude palm oil fatty acids in the plasmatic lipids of consumers

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ABSTRACT

Introduction: Among vegetal oils using in the world, palm oil is rating in a good position in Africa and the countries of south-east Asia. Our research is a study of collective supplementation which elaborated in a global frame of valorization of vegetal oils consumed in Côte d'Ivoire.

Materials and Methods: This study concerned 30 participants apparently in good health. Experimentation lasted 15 days, and participants were private d of whole consumption of fat before and after supplementation. The supplementation has been done during the lunch by addition of 70 grams of crude palm oil in the rice after cooking and contained a portion of rice with lean fish. Every participant received this meal throughout the supplementation. The blood have been picked prior to the onset of experimentation (J₀) and then seven days after (J₇) and finally after fifteen days (J₁₅). The assay was realized by gas chromatography.

Results: The rate of saturated fatty acids in total lipids during supplementation decreased significantly from J₀ to J₁₅. Conversely, incorporation of monounsaturated and polyunsaturated in total lipids incremented in same time growing up respectively from 23.51 to 28.88 and from 39.27 to 39.58 for MUFA and PUFA.

Conclusion: Crude palm oil possesses common advantages of vegetal oils, nonetheless its high concentration of saturated disquiet researchers. The implementation of new cultivars poor in saturated fatty acids and enrich in unsaturated fatty acids will enable to fulfill the needs of health of several populations in the world.

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1. Introduction

The composition of our diet plays an important role in the steadying of our health and defines more or less its evolution. Nowadays, facing several assaults that we undergo and which affect our health, the best behaviour should be to act on those reflecting our lifestyle precisely diseases linked to inappropriate alimentation. Among different substrates brought by alimentation figure the fatty acids. Fats of our alimentation derive together from vegetal oils and animal fats. While animal fats bringing in majority saturated fatty acids (SFA) and cholesterol, vegetal oils providing as well SFA as monounsaturated fatty acids

(MUFA) and polyunsaturated fatty acids (PUFA).^{1,2}

Among vegetal oils use in the world, palm oil is rating in a preferable position as well in the countries of West Africa, central Africa as in the countries of south-east Asia.³ Palm oil is a solid vegetal oil, rich in saturated fatty acids (50%), mainly in palmitic acid. Also, it contains 50 % of unsaturated fatty acids and its level in tocotrienols and carotenoids is important but partly altered by refining and heating. Epidemiological studies are unusual and of poor quality, so these data are discussed under the light on the actual concept based on the implication of saturated fatty acids in cardiovascular diseases.⁴ Thus, a frequent and excessive consumption of palm oil in our diet, through manufactured products, could be deleterious. Nonetheless the adverse effects of palm oil consumption are not well known. Despite its contents, there is a persistence of several

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controversies on the benefit effects of palm oil consumption related to its contain of saturated fatty acids.³ Several studies conducted in Africa and in the world focused on the beneficial effects of palm oil consumption on the changes of biological parameters are available without bringing irrefutable evidence of its action.^{5,6}

Our research is a study of collective supplementation which is elaborated in a global frame of valorization of vegetal oils consumed in Côte d'Ivoire. This study concerned the repartition of fatty acids of crude palm oil in the plasmatic lipids of consumers during a certain delay due to its wide use in West Africa and particularly in Côte d'Ivoire.

2. Materials and Methods

2.1. Participants

It was an interventional essay related to collective supplementation. This study was focused on 30 participants apparently in good health including 15 women and 15 men. Were included in this study, black volunteers aged at least 25 years old and 45 years old at most, without any hepatic, metabolic, cardiovascular and infectious diseases. Weren't included, obese participants, leans, smokers or alcoholics, likewise participants having a report of dyslipidemia, hyperuricemia or another metabolic disease. Each participant gave a lightened consent. The protocol was approved by the unit of training and research of medical sciences (Félix Houphouët-Boigny University), and had been explained to the participants before their approbation.

2.2. Confection of crude palm oil

Crude palm oil is usually used in each household and that oil is artisanally extracted from palm seeds. Extraction is done after separating, cooking of seeds and pressing. Palm oil resulting is extracted by warm pressure of palm seeds, approximately 100 kg of fruits produce 22 kg of oil. This oil obtained is commercialized such as a native oil of red colour. Its rate of carotenoids augments the level of vitamin A, resistant to high temperatures and it is mostly used for cooking.

2.3. Protocol of experimentation

Experimentation lasted 15 days, during which, participants were private of any consumption of fat food before and after the supplementation. Supplementation has been done during the lunch. The menu was made of a portion of rice with lean fish. Supplementation has been realized by addition of 70 grams of crude palm oil (7 soup spoons) in the rice after cooking. Every participant received this meal throughout the supplementation. Every participant had to go into the laboratory of medical biochemistry in the morning to undergo the venipuncture and at the lunch time to take the

meal.

2.4. Blood collection

The blood samples have been picked prior to the onset of experimentation (J_0) and then seven days after (J_7) and finally after fifteen days (J_{15}). For all samples, participants had been fasting since the previous evening (10 to 12 hours). Blood has been collected by venipuncture and gathered into dry vacutainer® tubes. After five minutes of centrifugation (4000 r/min), the specimen has been separated into aliquots. Aliquots have been conserved at -20°C in our laboratory, before being forwarded in dry ice to Lapeyronie in France. Aliquots have been kept again at -20°C until the moment of analyzes.

2.5. Laboratory methods

Dosage of fatty acids was made by gas chromatography, equipped with a flame ionization detector and an injector, coupled to a digital integrator, after extraction of the fatty acids. Free fatty acid methyl esters were measured according to the methods of Bondia et al.⁷ Results were expressed for each fatty acid as a percentage of total fatty acids.

2.6. Statistical analysis

Analyzes were performed using SPSS software version 3.11. The comparison of means was obtained by the student T-test. Results were expressed in means \pm standard deviation. The level of significance of the tests used was set at $\alpha = 5\%$, difference was considered significant for P value < 0.05 .

3. Results

Incorporation of SFA of palm oil increased throughout the supplementation in the different lipids fractions such as esterified cholesterol, phospholipids and triacylglycerols. Incorporation was significant in esterified cholesterol from (J_0) 23.42 to (J_{15}) 23.34 (Table 1). Inversely, we noted an absence of SFA's incorporation in total lipids, marked by a reduction which was significant from J_0 (34.53) to J_{15} (32.12). The rate of MUFA increased in the fraction of esterified cholesterol and total lipids during the assay. Increasing has been steady and significant for esterified cholesterol (J_0) 33.48 to (J_{15}) 34.55. However we registered a reduction of the rate of MUFA in phospholipids and triacylglycerols (Table 2).

Related to PUFA, we noted an absence of this trend in the fractions of esterified cholesterol, phospholipids together with in the triacylglycerols. The diminution of the rate of fatty acids in these fractions was significant for esterified cholesterol and triacylglycerols. We also observed a discreet incrementation of fatty acids in total

lipids (Table 2). Throughout the supplementation of palm oil, we noted a reduction of omega 6 incorporation in the different fractions, in contrary the rate of fatty acids increased during this period. Thus, the ratio of omega 6/omega 3 initially elevated for participants, diminished but stayed around 5 in most lipid fractions excepted phospholipids for which the level decreased down to 3.13 at the end of experimentation (Table 2).

4. Discussion

Fatty acids of crude palm oil are compounded of 45 – 55 % of SFA, 38- 45% of MUFA and 9-12% PUFA^{3,4,8} making it the most important vegetal oil rich in saturated fatty acids. Among them, palmitic acid, oleic acid and linoleic acid are the SFA most presented in the crude palm oil. According to some authors, regular consumption of palm oil increases the risk of atherosclerosis because palm oil increases cholesterol levels, LDL-C levels and HDL-C.^{4,9} Refined palm oil, bleached and deodorized, although is the most vegetal oil commercialized and used in the manufactured industries owing to its chemical properties.¹⁰ Crude palm oil using in different households in Africa is artisanally extracted and resist to a warm temperature. Lately, some varieties of palm oil selected as part of a genetic crossover by the Ivorian National Center of Agronomic research (CNRA- Côte d ' Ivoire) have been the subject of scientific reports mentioning a new varieties of palm seed in which the rate of UFA and SFA are respectively of 48-60% and 40-52%.^{3,5}

In their report, Voon et al.¹¹ didn't observe any difference related to the level of esterified cholesterol and triacylglycerol in a study regarding the effect between palm oil and olive oil. In contrast, others^{12,13} found an increasing level of total cholesterol, LDL -C and C-LDL/C-HDL ratio more importantly with food enrich in palm oil than those contain more PUFA. Vegetal oils rich in PUFA such as olive oil would have a favorable effect on the plasmatic lipids by decreasing the hepatic production of VLDL, LDL and total cholesterol.^{9,14} Otherwise, the high level of UFA should increase the susceptibility of these oils to oxidation which would have justified their hydrogenation and the culture of others cultivars having a less risk of oxidation.⁵

A meta- analysis published in 2010 didn ' t confirm a significant correlation between SFA and risk of cardiovascular diseases or cerebra vascular accidents.¹⁵ The link between the se diseases and SFA consumption would be submitted to several cofounding parameters explaining for partly the disparity in the findings of different studies. Only a few epidemiological studies tempted to take into consideration the role of palm oil on the risk of cardiovascular diseases.^{16–18}

As for the most food enrich in SFA, palm oil increases the level of C-LDL together with the C-HDL,^{4,19} due to its permanent consumption containing palmitic and oleic

acid.^{9,11,20} Its high level in oleic acid represents therefore a beneficial effect because more of 85% of SFA located in Sn-2 are unsaturated and means that the SFA are in peripheral positions Sn-1 and Sn-3 and thus less available.¹⁰ The intake of crude palm oil triggered an augmentation of PUFA concentration and in particular the fraction of fatty acids omega3 in all different lipid fractions. This trend reveals the benefit effect of the daily consumption of crude palm oil in our ali mentation. In fact, amongst PUFA, essential fatty acids are necessary for maintaining homeostasis, thus we have to integrate vegetal oil in our diet.¹⁸ The essential fatty acids play an important role in the good work of different systems such as neuronal, cardiovascular and immunology.²¹ The ω -6/ ω -3 ratio throughout the supplementation downed from 7.06 (J_0) to 5.60 (J_{15}). Crude palm oil should be relevant for household use according to European recommendations which stipulated that this ratio would not exceed five.²²

In a multivariable model, insulin and HOMA-IR were positively associated with the dietary ω -6/ ω -3 PUFA ratio. In vivo, some studies showed that mice fed up with a high dietary ω -6/ ω -3 PUFA ratio got higher levels of triglycerides in comparison with those fed up with lower ratio.²³ Otherwise, when rats were fed up with a diet with low ω -6/ ω -3 PUFA ratio, the level of glucose and insulin were improved; moreover, in some cases these changes were accompanied by a lower level of pro-inflammatory cytokines.²⁴ In the human's case, those who receive d a supplementation with ω -3 PUFAs, the arachidonic Acid/eicosapentanoic Acid ratio decreased, and this change was accompanied by a reduction of triacylglycerol level for the participants.²⁵ A dditionally, crude palm oil is an important source of natural compounds and carry an important amount of polyphenolic that could reduce the activities of the free radical.²⁶ This oil widely consumed in Africa, presents many advantages as well economic, nutritional as health benefit because the high level of MUFA down s the level of LDL-cholesterol while maintaining HDL-concentration.²⁷ Moreover, due to its high concentration of antioxidants, palm oil has got a long delay of conservation rather than the others nutritive vegetal oils and which makes it particularly resistant to rancidity.

These two latest beneficial effects of palm oil in the prevention of any cardiovascular diseases regardless the adverse consequences linked to high concentration of SFA derived from vegetal oil, could motivated its prescription such as a support of medical treatment in some cases. But, we have to hearten and stand the entire endeavour carried out by the Ivorian Center of Research in Agronomy (CNRA) in order to obtain new cultivars of palm seeds having lower concentrations of SFA compared to MUFA and PUFA.

Table 1: Rate of saturated fatty acids in the different lipid fractions before and after supplementation

	Rate of fatty acids (%)			Saturated fatty acids
	Myristic acid	Palmitic acid	Stearic acid	
Esterified cholesterol				
J0	0.48± 0.40	20.95± 15.77	1.98 ± 1.54	23.42± 17.68
J7	0.43± 0.25	21.57± 14.64	2.59± 2.29	24.60± 16.71
J 15	0.51± 0.49	21.73± 16.14	2.09 ± 1.27	24.34± 17.85
J0 vs J7 (<i>P</i>)	0.008*	0.000**	0.009*	0.000**
J0 vs J 15 (<i>P</i>)	0.001*	0.000**	0.000**	0.000**
Phospholipids				
J0	0.13± 0.08	29.76± 7.12	17.48± 3.87	47.39± 8.23
J7	0.21± 0.23	35.37± 7.34	19.51± 4.36	55.10± 11.60
J 15	0.21± 0.10	34.18± 5.56	18.77± 4.29	53.17± 6.33
J0 vs J7 (<i>P</i>)	0.180	0.943	0.332	0.538
J0 vs J 15 (<i>P</i>)	0.228	0.224	0.104	0.975
Triacylglycerols				
J0	0.78± 0.90	25.79±3.88	5.69± 0.83	32.27± 4.27
J7	0.46± 0.29	26.39± 3.76	5.45± 1.17	32.31± 3.85
J 15	0.54± 0.39	28.20± 2.35	6.23± 0.99	34.98± 2.90
J0 vs J7 (<i>P</i>)	0.688	0.054	0.443	0.51
J0 vs J 15 (<i>P</i>)	0.274	0.403	0.006*	0.35
Total lipids				
J0	0.41 ± 0.15	25.80 ± 6.37	8.31 ± 2.24	34.53 ± 8.61
J7	0.35 ± 0.11	23.89± 1.74	7.34± 0.70	31.68± 2.20
J 10	0.42 ± 0.20	25.80± 6.37	8.31± 2.24	32.12± 1.75
J0 vs J7 (<i>P</i>)	0.318	0.460	0.323	0.145
J0 vs J 15 (<i>P</i>)	0.946	0.578	0.258	0.007*

* Significant ** Highly Significant

Table 2: Rate of polyunsaturated fatty acids in the different lipid fractions before and after supplementation

	Fatty acids rate (%)			
	Omega 6	Omega 3	Polyunsaturated fatty acids (PUFAs)	Omega6/Omega 3
Esterified Cholesterol				
J0	34.19± 5.29	4.84±1.59	43.09± 19.21	7.06
J7	33.25± 1.75	6.67± 3.97	40.90± 17.90	4.98
J 15	33.42± 1.90	5.96± 1.58	41.09± 17.66	5.60
J0 vs J7 (<i>P</i>)	0.095	0.893	0.000**	0.316
J0 vs J 15 (<i>P</i>)	0.267	0.930	0.000**	0.440
Phospholipids				
J0	26.70± 5.69	6.66± 1.82	35.17± 2.07	4.00
J7	22.80± 9.06	6.14± 3.08	29.28± 11.58	3.71
J 15	23.71± 5.24	7.57± 3.44	31.60± 8.14	3.13
J0 vs J7 (<i>P</i>)	0.157	0.798	0.968	0.471
J0 vs J 15 (<i>P</i>)	0.036*	0.824	0.972	0.202
Triacylglycerols				
J0	15.28± 3.91	1.88± 0.91	17.43± 4.73	8.12
J7	13.08± 3.05	1.79± 0.84	15.13± 3.82	7.30
J 15	13.36± 2.51	2.18± 1.37	15.75± 3.79	6.12
J0 vs J7 (<i>P</i>)	0.011*	0.049*	0.005*	0.429
J0 vs J 15 (<i>P</i>)	0.018*	0.187	0.039*	0.149
Total lipids				
J0	34.19± 5.29	4.84± 1.59	39.27± 5,97	7.06
J7	33.25±1.75	6.67±3.97	40.15± 3,53	4.98
J 15	33.42± 1.90	5.96±1.58	39.58± 2,47	5.60
J0 vs J7 (<i>P</i>)	0.095	0.893	0.044*	0.316
J0 vs J 15 (<i>P</i>)	0.267	0.930	0.036*	0.440

* Significant ** Highly Significant

5. Conclusion

Our study certainly highlighted on the incidence of crude palm oil on the incorporation and distribution of fatty acids in plasmatic lipids. We noted an augmentation of incorporation of SFA in the different lipid fractions together with the MUFA in the total lipids. Nonetheless, the consumption of crude palm oil revealed some benefit effects on the omega6/omega3 ratio which could be advantageous on the sustaining of health. Although, the impact of its consumption on the triggering of cardio-vascular diseases is not elucidated. Implementation of new cultivars poor in saturated fatty acids and enrich in unsaturated will enable to fulfill the needs of health of several populations in the world according to its wide consumption precisely in the low income countries.

6. Limitations

Two major difficulties have obviously impacted the quality of our results; these are the short length of the study and the size of our sample. It has been difficult to obtain the free agreement of participants as regards the condition of implementation of this study. Another study more framed and subsidized could help to draw accurate conclusions in order to adjust our sights about palm oil consumption and precisely crude palm oil.

7. Source of funding

None.

8. Conflict of interest

The authors stated that there is no conflict of interest.

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