

Replacement of Dietary Fat With Palm Oil: Effect on Human Serum Lipids, Lipoproteins and Apolipoproteins

Sundram K, Hornstra G, et al. (1992). Replacement of dietary fat with palm oil: effect on human serum lipids, lipoproteins and apolipoproteins. Br J Nutr. **68(3):677-92.**

ABSTRACT: Thirty-eight male volunteers participated in a double-blind cross-over trial evaluating the effect of replacing the usual sources of saturated fat in the Dutch diet (animal fats and hydrogenated oils) by palm oil, which is virtually free of cholesterol and trans-fatty acids, on serum lipids, lipoproteins and apolipoproteins.

Maximum (about 70%) replacement had no significant effect on serum total cholesterol or most lipoprotein fractions, but resulted in an 11% increase in serum high-density-lipoprotein (HDL)2-cholesterol relative to the control ($P_2 = 0.01$). The palm-oil diet also caused an 8% decrease in low-density-lipoprotein (LDL):HDL2 + HDL3-cholesterol ratio ($P_2 = 0.02$) as well as a 9% decrease in triacylglycerols in the low-density-lipoprotein fractions ($P_2 = 0.01$). Palm oil consumption resulted in a 4% increase in serum apolipoprotein AI ($P_2 = 0.008$) and a 4% decrease in apolipoprotein B ($P_2 = 0.01$) relative to the control diet; the B:AI apolipoprotein ratio was decreased by 8% ($P_2 < 0.0001$).

These results were not significantly affected by the different lipoprotein E phenotypes of the volunteers. Although the observed differences were relatively modest, the present study, nonetheless, indicates that dietary palm oil, when replacing a major part of the normal fat content in a Dutch diet, may slightly reduce the lipoprotein- and apolipoprotein-associated cardiovascular risk profiles.

Characteristics of Volunteers in the Study (n=38)

Characteristic	Mean	Range
Age (years)	35.70	19-45
BMI (kg/m ²)	23.80	20.1-26.4
Serum cholesterol (mmol/l)	5.13	3.50-6.40
HDL-cholesterol (mmol/l)	1.08	0.70-1.80
Serum triacylglycerols (mmol/l)	0.99	0.27-2.08

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Nutrient Intake Immediately Before (Habitual) and During the Replacement of Dietary Fat With Palm Oil as Calculated from Repeated Dietary History

	Habitual	Palm Oil (PO)	Control (CT)	(PO) – (CT)
Variable	Mean	Mean	Mean	Mean
Energy (MJ/d)	13.3	14.6	14.4	0.1
Fat energy (%)	39.2	41.0	41.1	-0.1
Fat energy, PO (%)	-	28.7	NIL	-
PUFA (% energy)	7.0	6.8	6.9	-0.2
SFA (% energy)	16.7	17.2	16.3	0.9
MUFA (% energy)	15.5	17.1	17.8	-0.8
P:S ratio	0.40	0.40	0.43	-0.04

- PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; P:S, Polyunsaturated:saturated fatty acids.

Fatty Acid Composition of Lipids Extracted from Duplicate Portions Collected Over 48h Period for Subjects On Control or Palm Oil Diets

Fatty Acid (g/100g Total Fatty Acids)	Palm Oil	Control
	Mean	Mean
10:0	0.2	0.4
12:0	1.8	2.0
14:0	2.4	4.7
15:0	0.1	0.4
16:0	28.6	20.8
16:1 (n-7)	1.4	2.7
17:0	0.3	0.6
18:0	6.9	8.6
18:1 (n-9)	38.7	37.2
18:2 (n-6)	14.3	12.7
20:0	0.5	0.6
18:3 (n-3)	2.0	2.6
20:1 (n-9)	0.8	1.8
22:0	0.2	0.4
22:1 (n-9)	0.2	0.6
SFA	41.1	38.6
PUFA	16.4	15.4
MUFA	41.1	42.3
P:S ratio	0.4	0.4
(n-6) : (n-3) ratio	7.4	5.1

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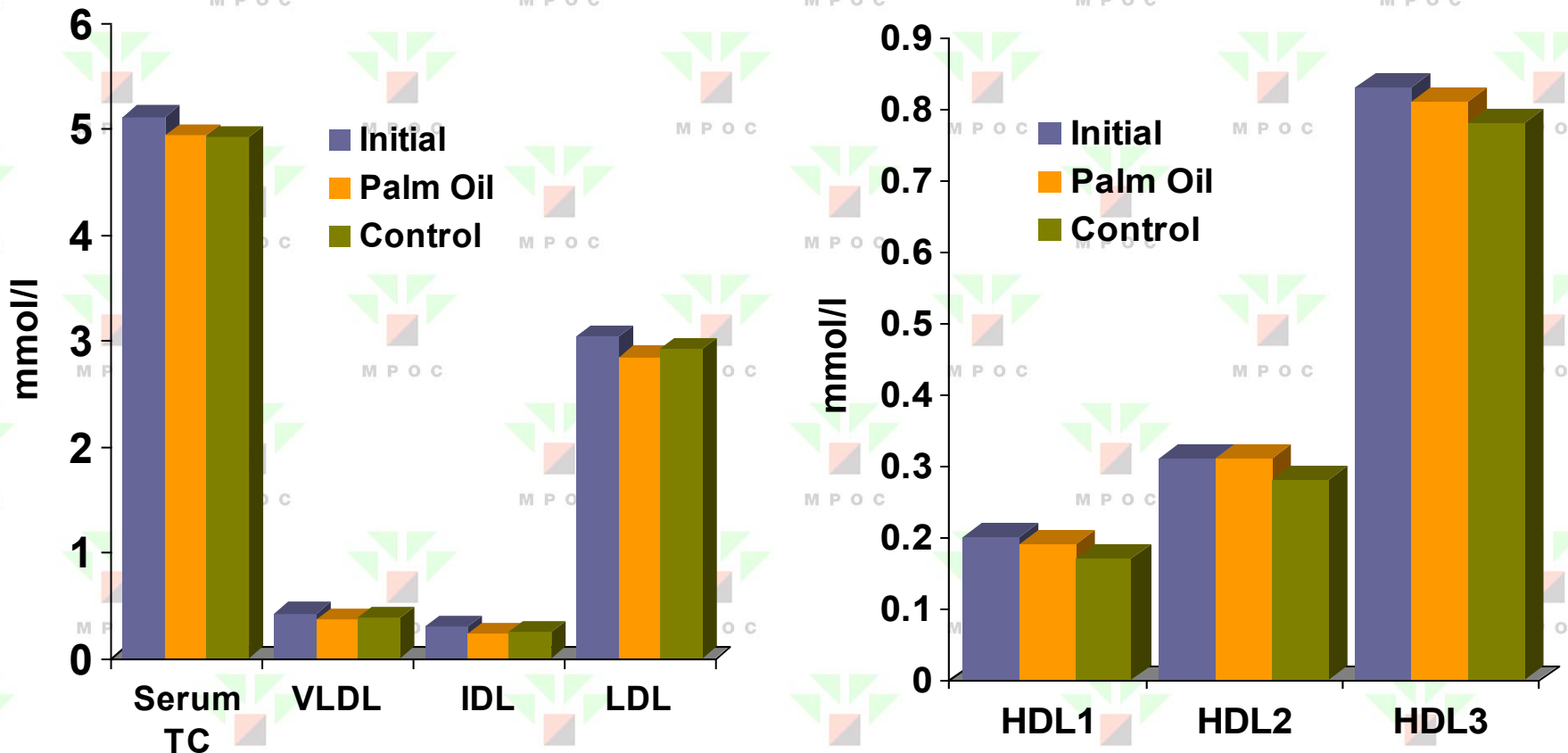
Fatty Acid Composition of Serum Triacylglycerols After Dietary Treatments for Subjects Given Control and Replaced by Palm Oil Diet

Fatty Acid (g/100g Total Fatty Acids)	Palm Oil	Control
	Mean	Mean
14:0	1.0	1.3
16:0	23.2	20.9
16:1 (n-7)	4.5	5.4
17:0 ^c	0.6	0.8
18:0	3.2	3.3
18:1 (n-9)	41.4	40.1
18:2 (n-9)	0.3	0.8
18:2 (n-6)	17.9	18.2
18:3 (n-6)	0.4	0.5
20:0	0.1	0.2
18:3 (n-3)	1.7	2.1
21:0 ^f	0.2	0.4
20:3 (n-9)	0.2	0.3
20:3 (n-6)	0.2	0.2
20:4 (n-6)	1.2	1.2
20:5 (n-3)	0.3	0.3
24:0	0.1	0.1
22:4 (n-6)	0.2	0.2
22:5 (n-3)	0.4	0.5
22:6 (n-3)	0.6	0.7
SFA	28.5	27.1
PUFA	23.6	25.0
MUFA	46.4	46.2
(n-6) : (n-3) ratio	8.4	7.2
SCFA	1.0	1.4

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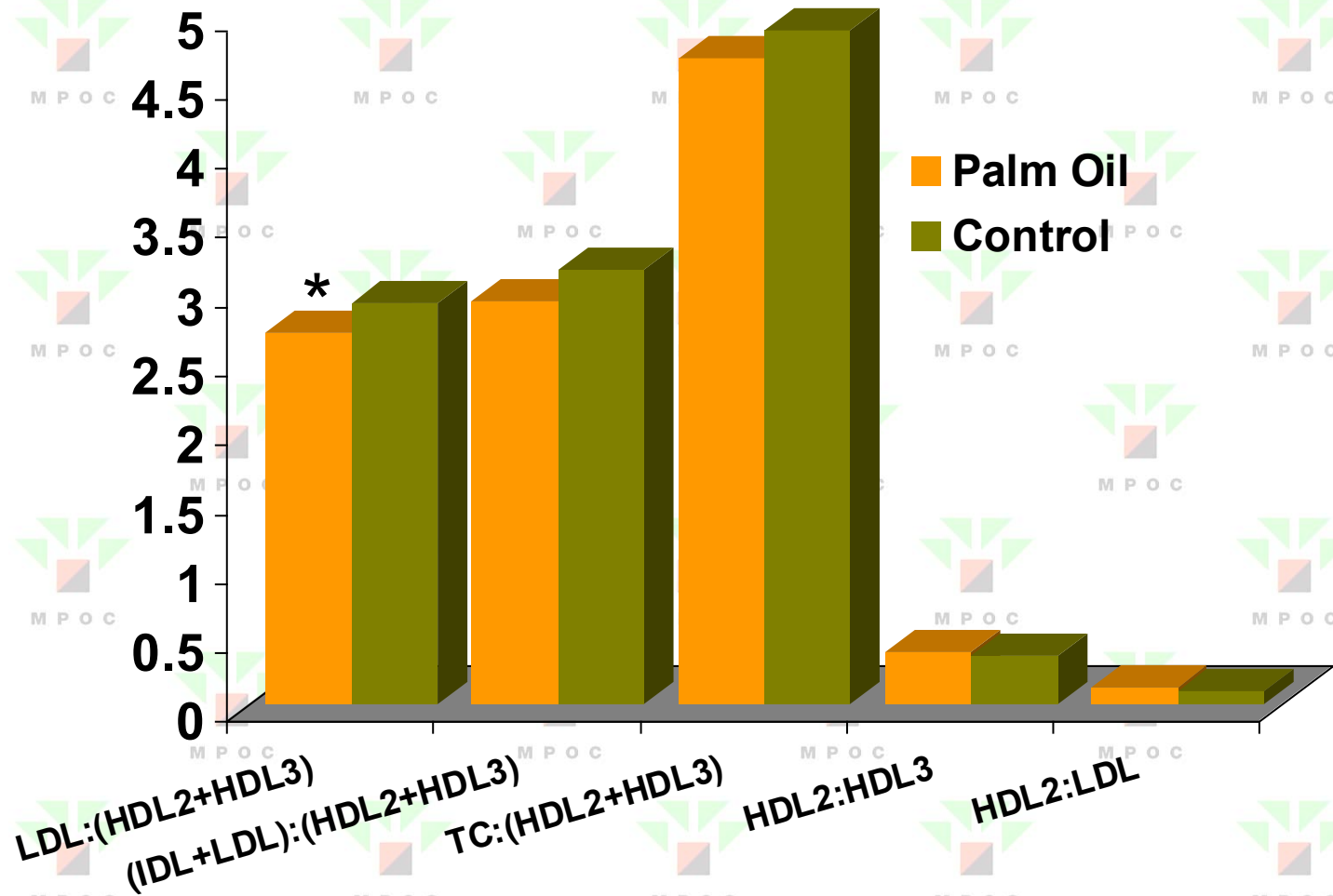
Credit: Dr. K. Sundram, 2013

Serum Total (TC) and Lipoprotein-cholesterol Levels Before and After Dietary Treatments for Subjects Given the Control Diet or the Diet Replaced by Palm Oil



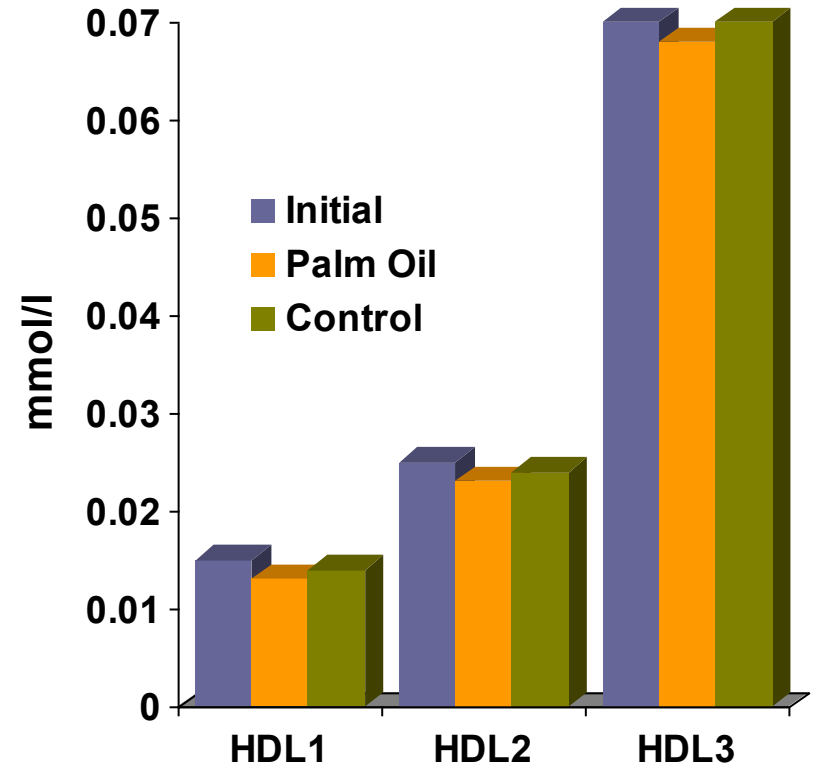
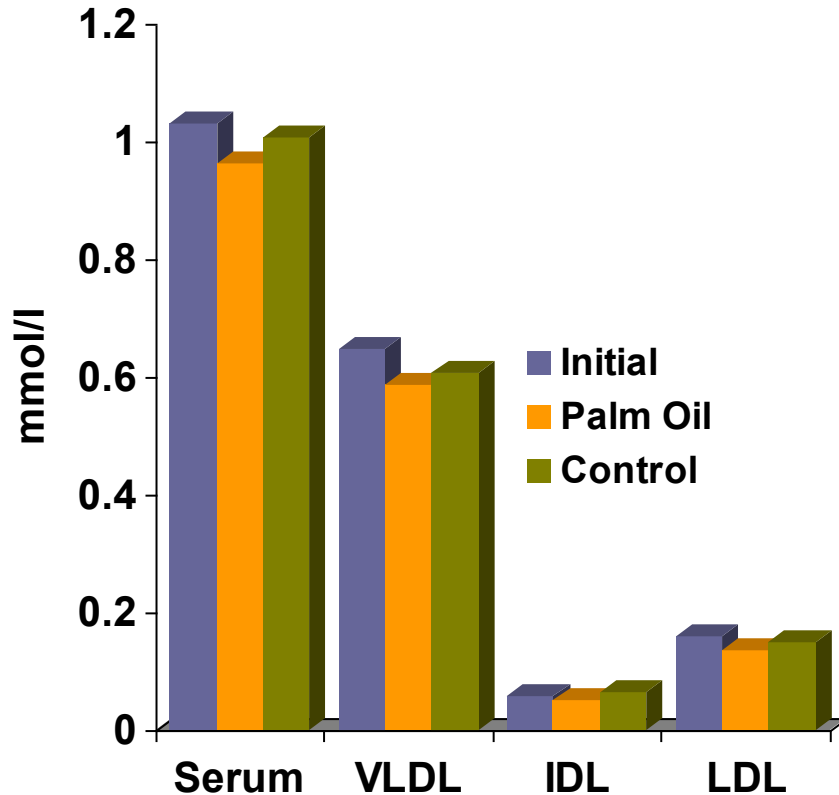
HDL₂-C significantly increased when replaced by palm oil.

Effect Of Replacement Of Dietary Fat With Palm Oil On Lipoprotein Cholesterol Ratios Of Volunteers



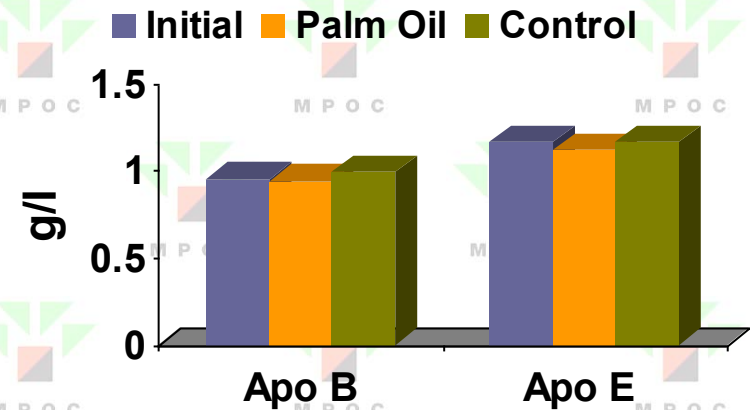
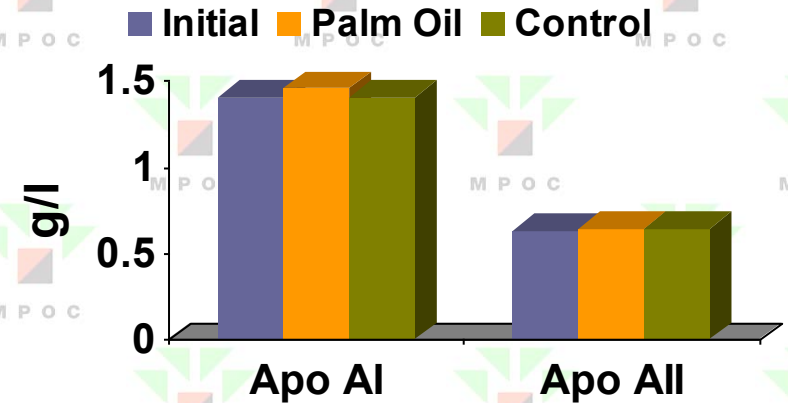
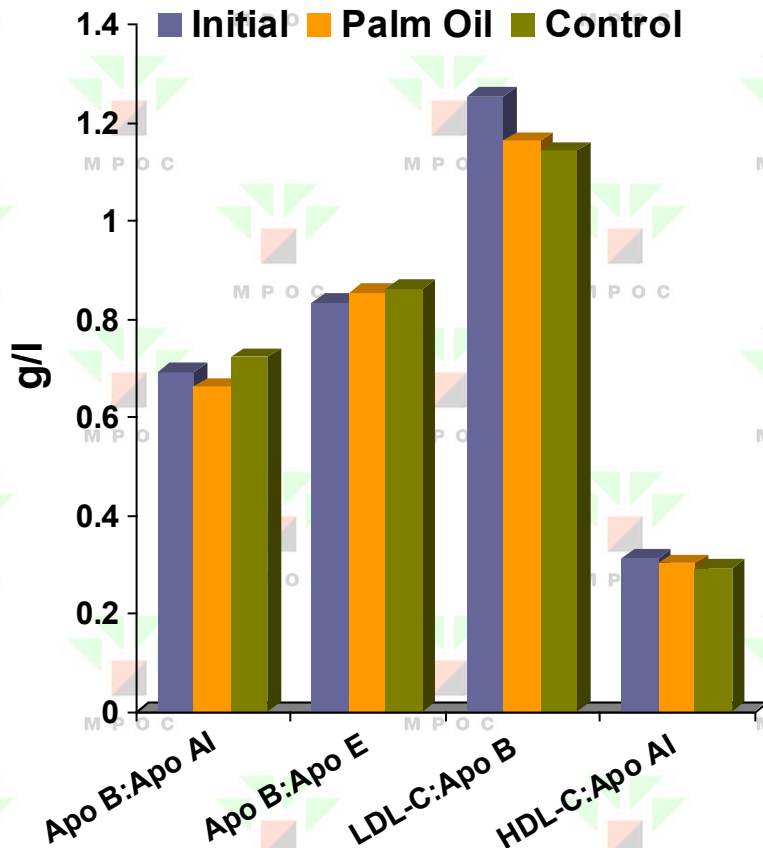
* Significant reduction in LDL: (HDL₂ + HDL₃)- cholesterol ratio.

Effect of Replacement of Dietary Fat With Palm Oil on Serum and Lipoprotein Triacylglycerols of Volunteers



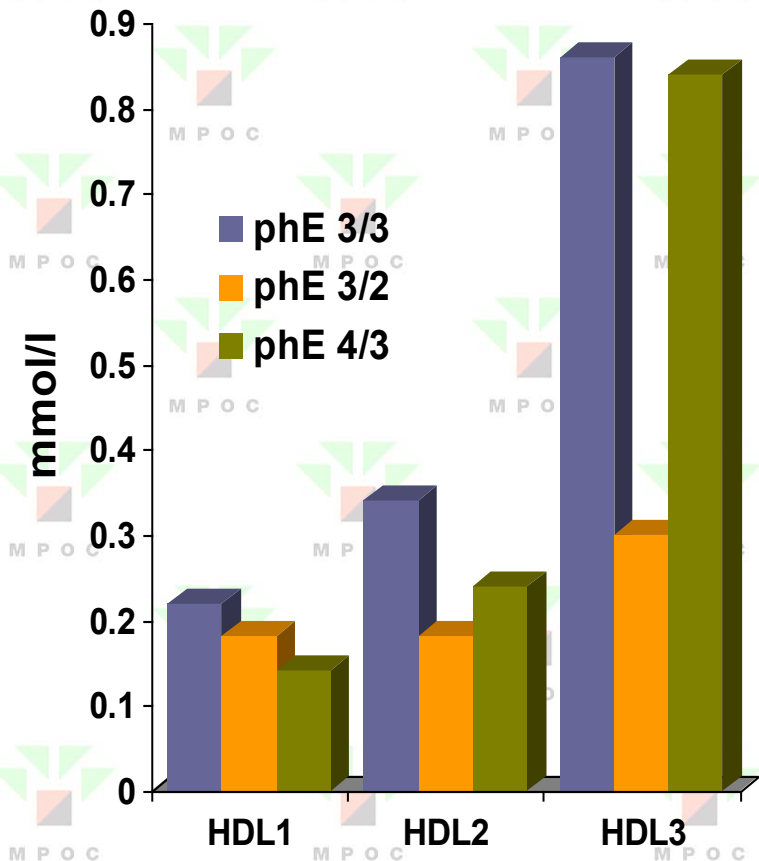
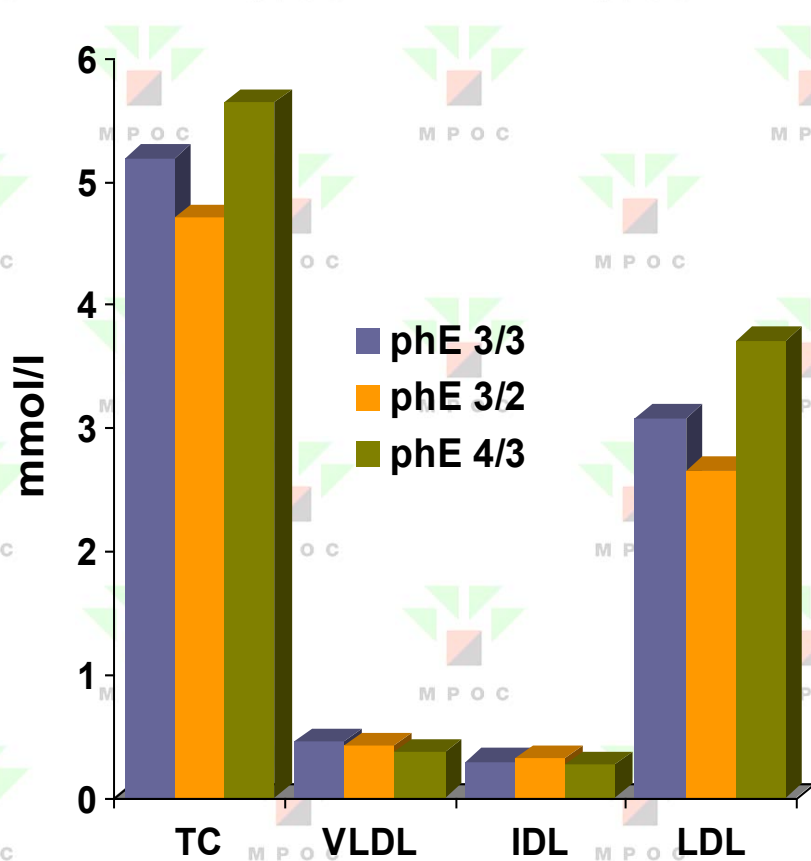
Palm oil lowered TG in all lipoprotein fractions

Effect of Replacement of Dietary Fat with Palm Oil on Serum Apolipoproteins and Their Calculated Ratios



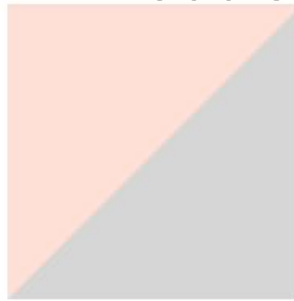
serum Apolipoprotein A1 increased, Apo B and B:A1 Apolipoprotein ratio decreased when replaced with palm oil.

Initial Levels of Serum (TC) and Lipoprotein-cholesterol of the Volunteers According to Apo E Phenotypes (phE)



Conclusion

When replacing the dietary fat in an European (Dutch) diet with palm oil, lipoprotein and apolipoprotein associated cardiovascular risk factors were beneficially modulated



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