

Nutritional properties of tropical oils



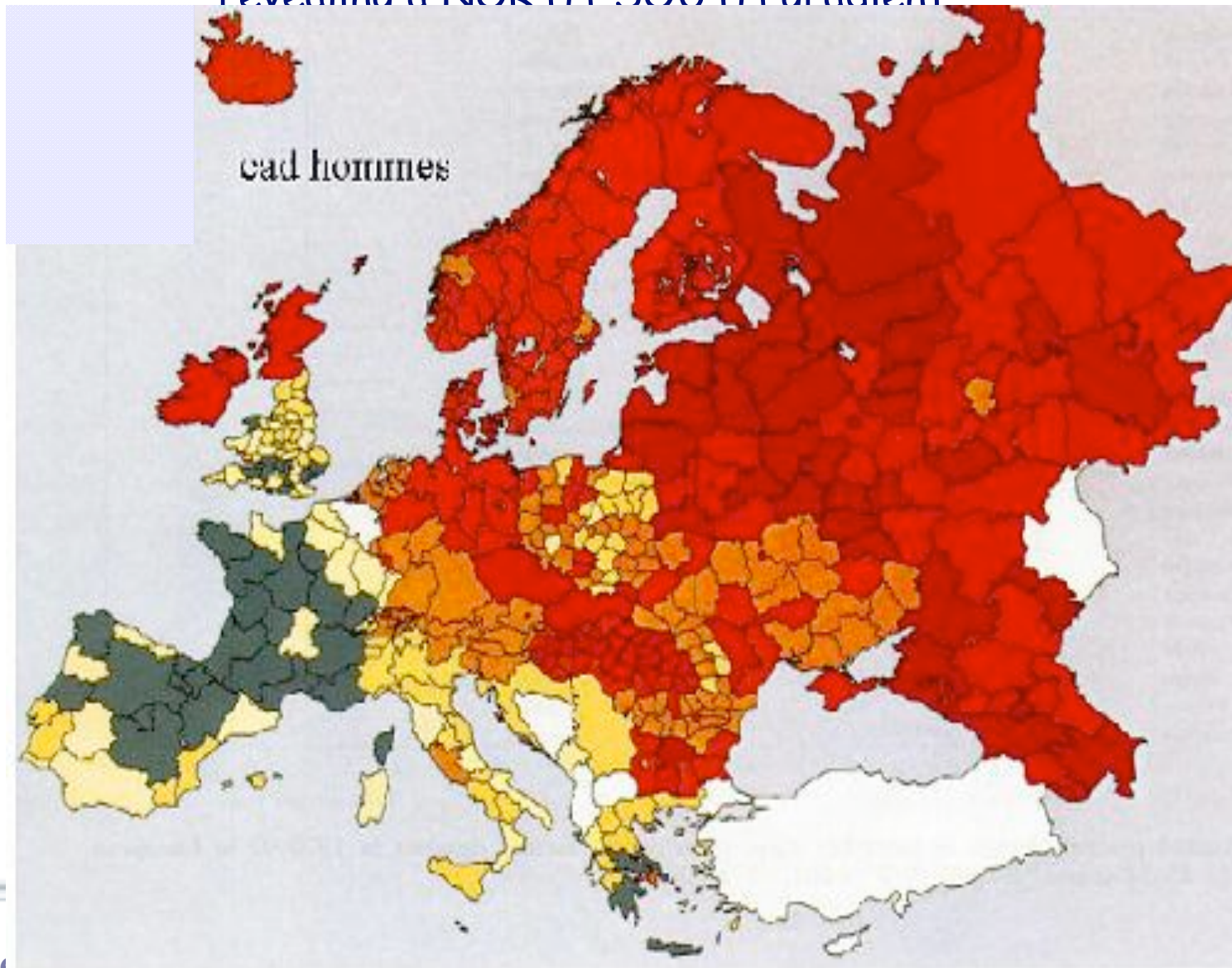
C. Vaysse

Equipe Nutrition Métabolisme & Santé

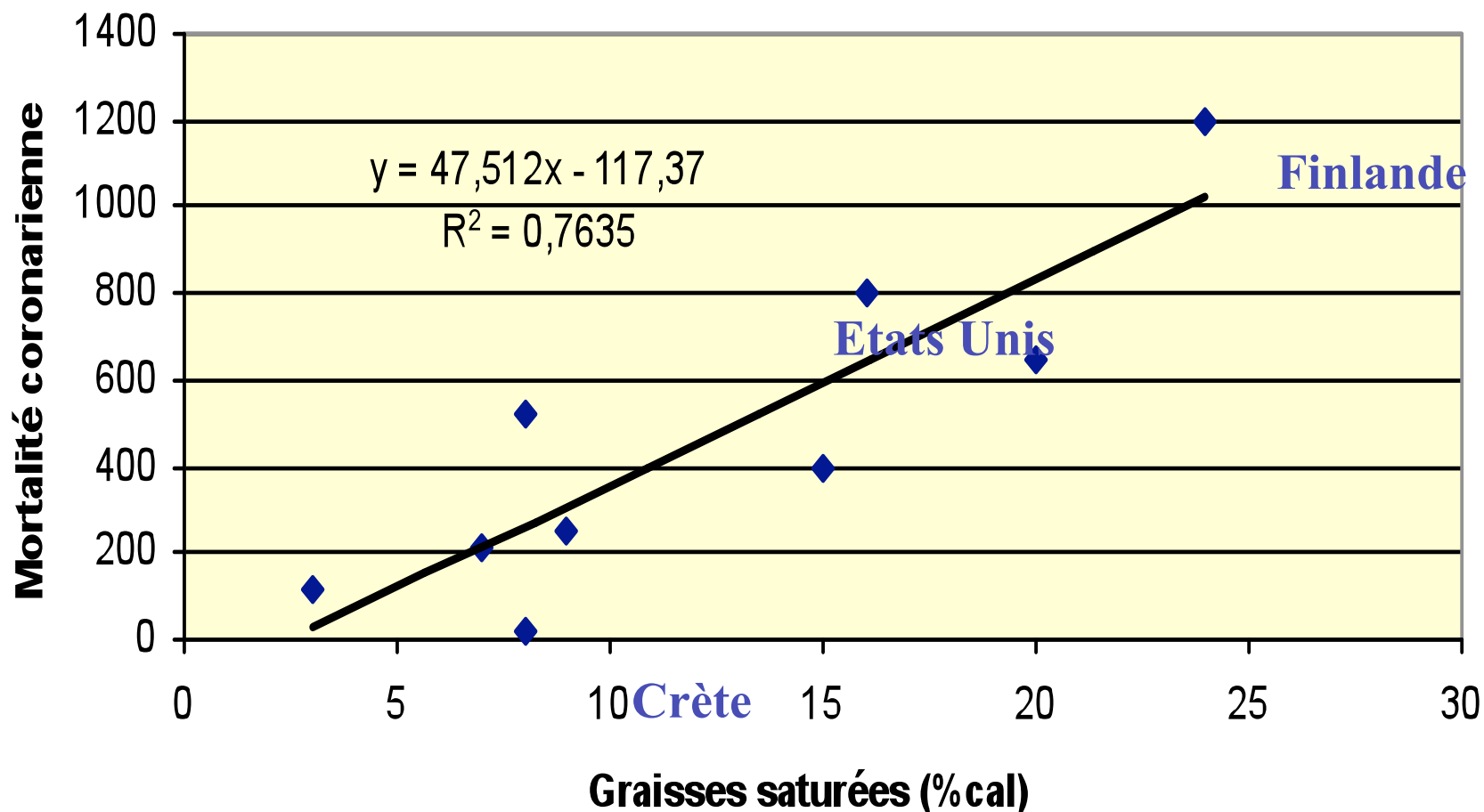


Atherosclerosis epidemiology .

Geographical differences of the incidence of coronary artery disease in Europe revealing a NORTH-SOUTH gradient



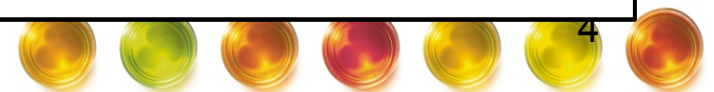
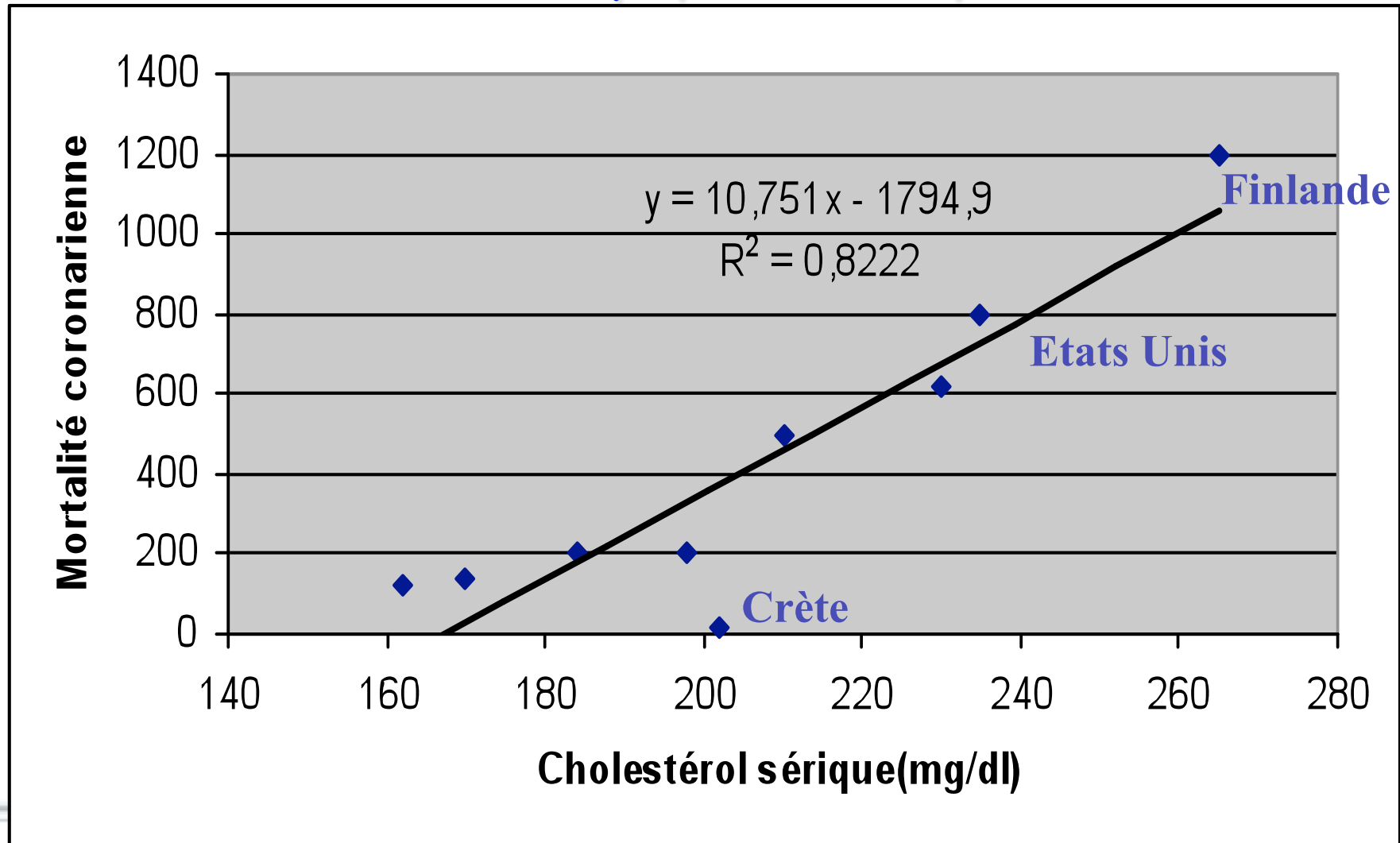
Relation between saturated fat intake and coronary mortality (Etude des 7 pays ; A. Keys - 1986)





Relation between serum cholesterol level and coronary mortality

(Etude des 7 pays ; A. Keys - 1984)



Dietary fatty acid sources

	Formula	Common food sources
Saturated		
Lauric	12:0	Coconut oil, palm kernel oil
Myristic	14:0	Coconut oil, palm kernel oil, dairy products
Palmitic	16:0	Dairy products, meat, palm oil
Stearic	18:0	Cocoa butter, meat
MUFA		
Oleic	Cis-18:1	Olive oil, rapeseed oil, meat
Elaidic	Trans-18:1	Hydrogenated fats
PUFA		
Linoleic	18:2n-6	Sunflower, maize and safflower oils
α -Linolenic	18:3n-3	Linseed oil, soyabean oil, vegetables
EPA	20:5n-3	Fish, marine mammals
DHA	22:6n-3	Fish, marine mammals

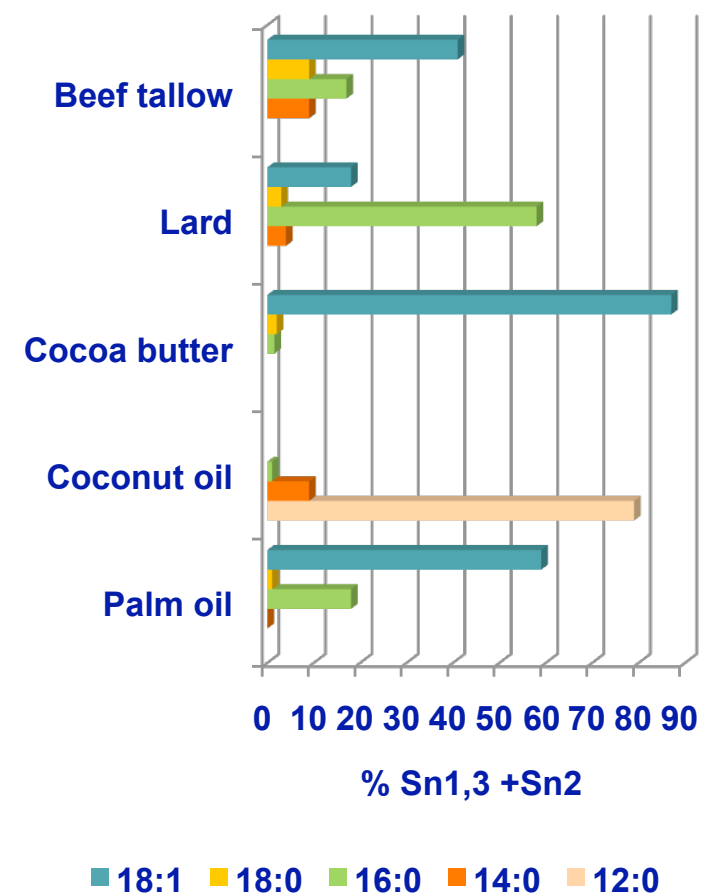


Fatty acid composition of some saturated fats and oils

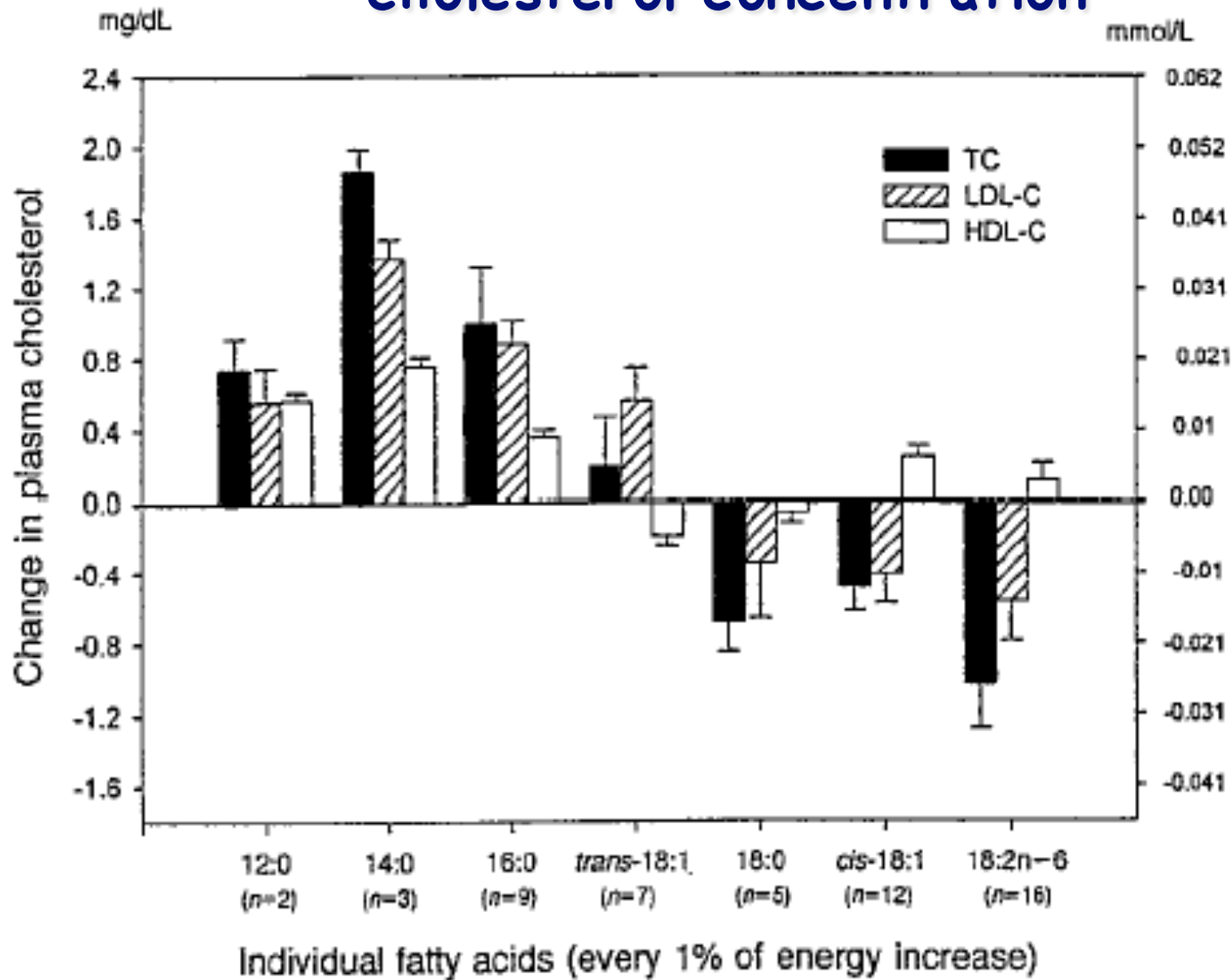
Fatty acid composition

	Unsat/ Sat	SFA					MUFA	PUFA	
		C10:0	C12:0	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3
Cocoa Butter	0.6	-	-	-	25	38	32	3	-
Coconut Oil	0.1	6	47	18	9	3	6	2	-
Palm Oil	1.0	-	-	1	45	4	40	10	-
Palm Olein	1.3	-	-	1	37	4	46	11	-
Palm Kernel Oil	0.2	4	48	16	8	3	15	2	-
Beef Tallow	0.9	-	-	3	24	19	43	3	1
Butterfat	0.5	3	3	11	27	12	29	2	1
Lard	1.2	-	-	2	26	14	44	10	-

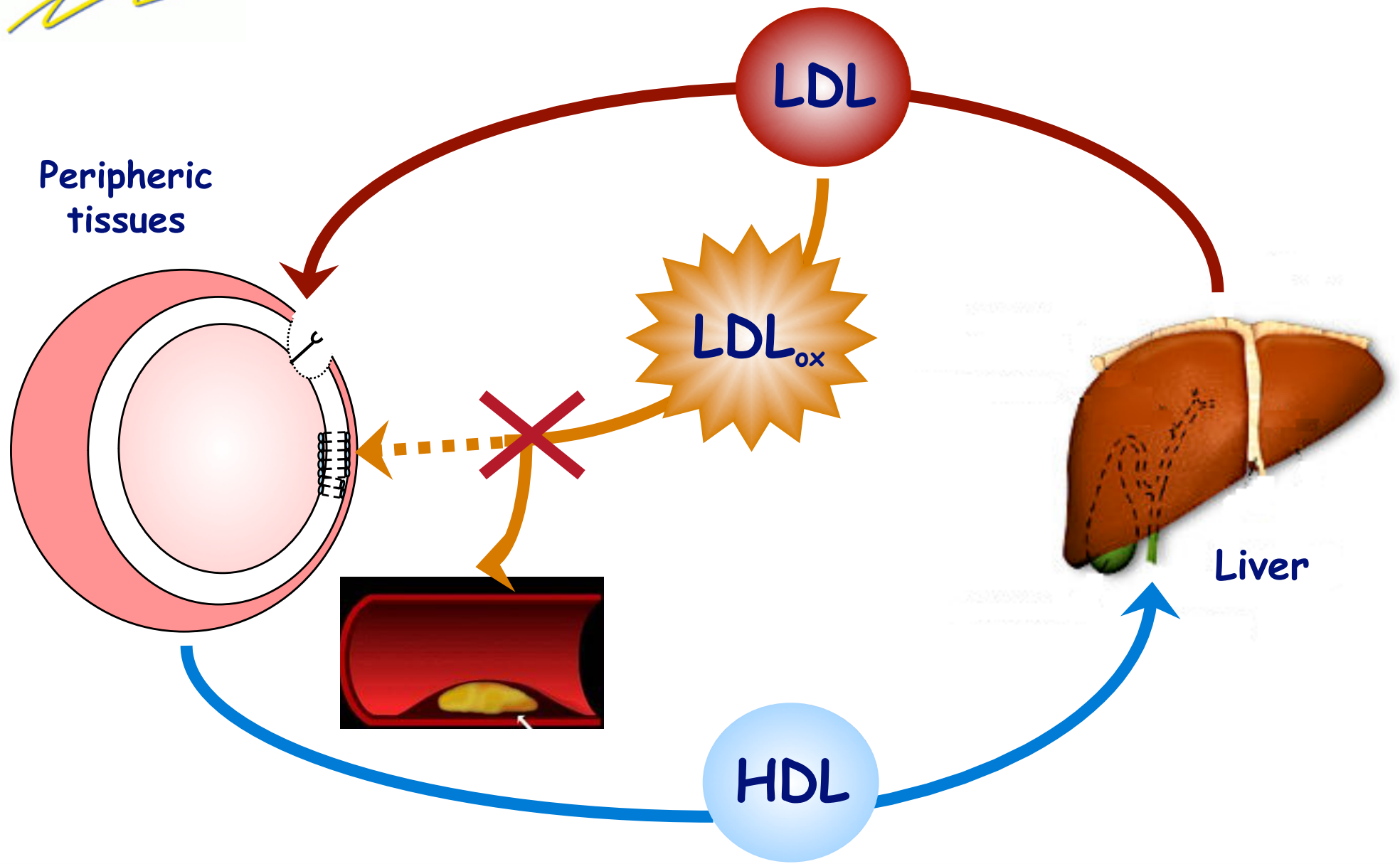
TG structure



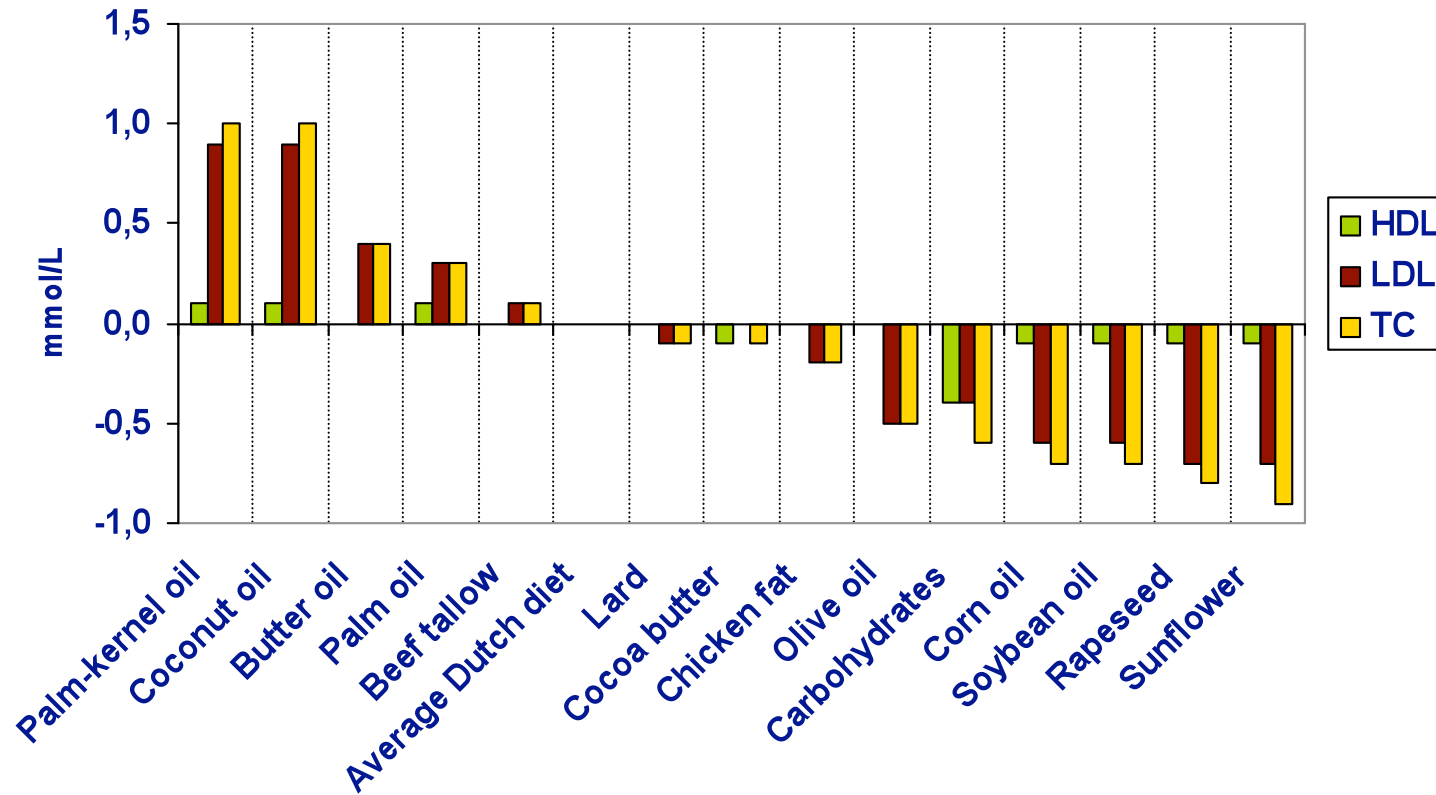
Impact of dietary fatty acids on plasma cholesterol concentration



Plasma cholestérol metabolism



Predicted effects on serum lipids of particular fats (compared with an average dutch diet)



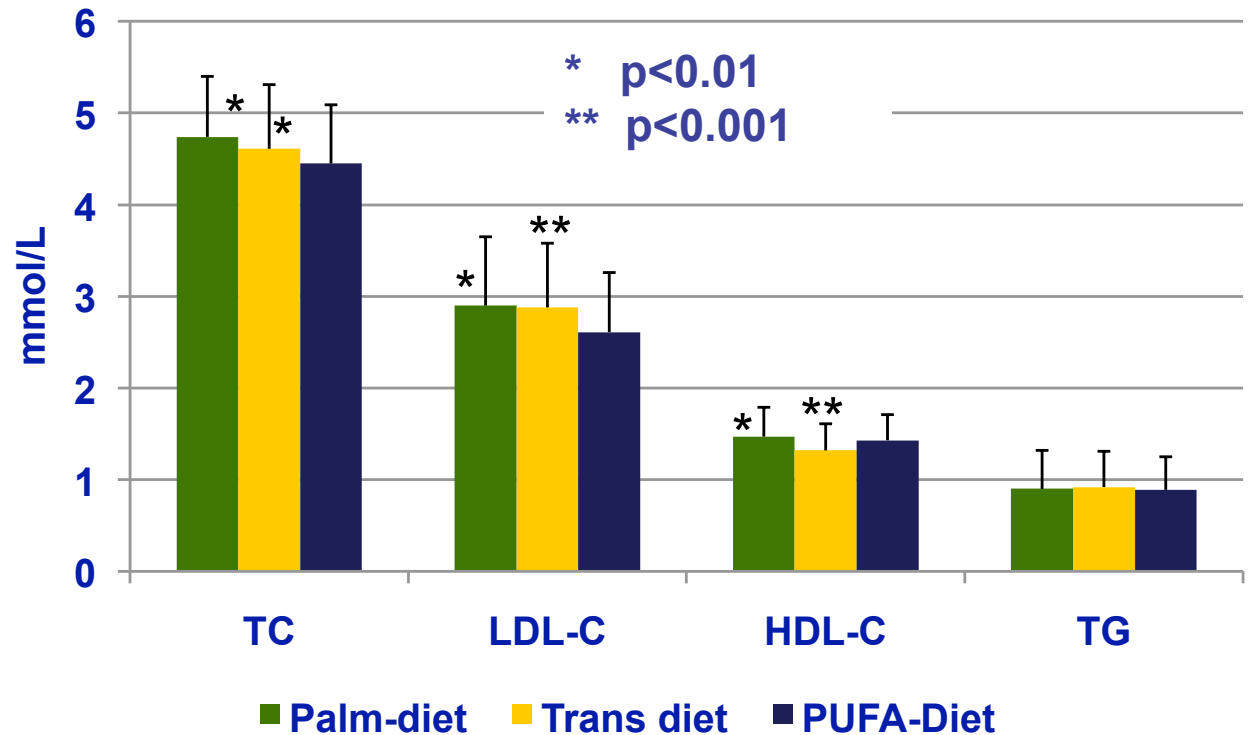
Katan MB et al (1994) AJCN 60 :1017S-1022S





Comparison of palm oil, partially hydrogenated vegetable oil and polyunsaturated vegetable oil on plasma cholesterol level in 27 young women

	Palm-diet % of total fatty acids	Trans diet % of total fatty acids	PUFA-Diet % of total fatty acids
16:0	33,9	11	15,8
18:1t	0,1	22,6	0,2
18:2 n-6	16	13,5	27,3



Compared with polyunsaturated vegetable oil : palm oil is less favorable on plasma cholesterol level.

Palm oil may be a reasonable alternative to partially hydrogenated vegetable oil in margarine.

Müllera H. et al., *Lipids* 33, 879–887 (1998).





Effect of different palm oil preparations and coconut oil on plasma cholesterol level and aortic cholesterol accumulation in hypercholesterolemic hamsters

	Coconut oil	RPO*	RBD-PO**	Reconstituted RBD-PO***
	<i>(% of total fatty acids)</i>			
12:0	44,6	0,3	0,3	0,3
14:0	16,8	1,0	1,0	1,0
16:0	8,2	33,7	39,1	39,2
18:0	2,8	3,3	3,9	3,9
18:1 (n-9)	5,8	47,1	43,6	44,3
18:2 (n-6)	1,8	13,6	11,3	10,9
18:3 (n-3)		0,6		
Total Vitamin E (mg/100g)	3,6	73,2	62	97,2
a-tocopherol (mg/100g)	0,4	16,2	15,8	26,6
Phytosterols (mg/100g)	86	57	47	53
Carotenoids (mg/100g)		70,6	1,2	78,1

* RPO = Red palm oil

**RBD-PO = refined, bleached and deodorized

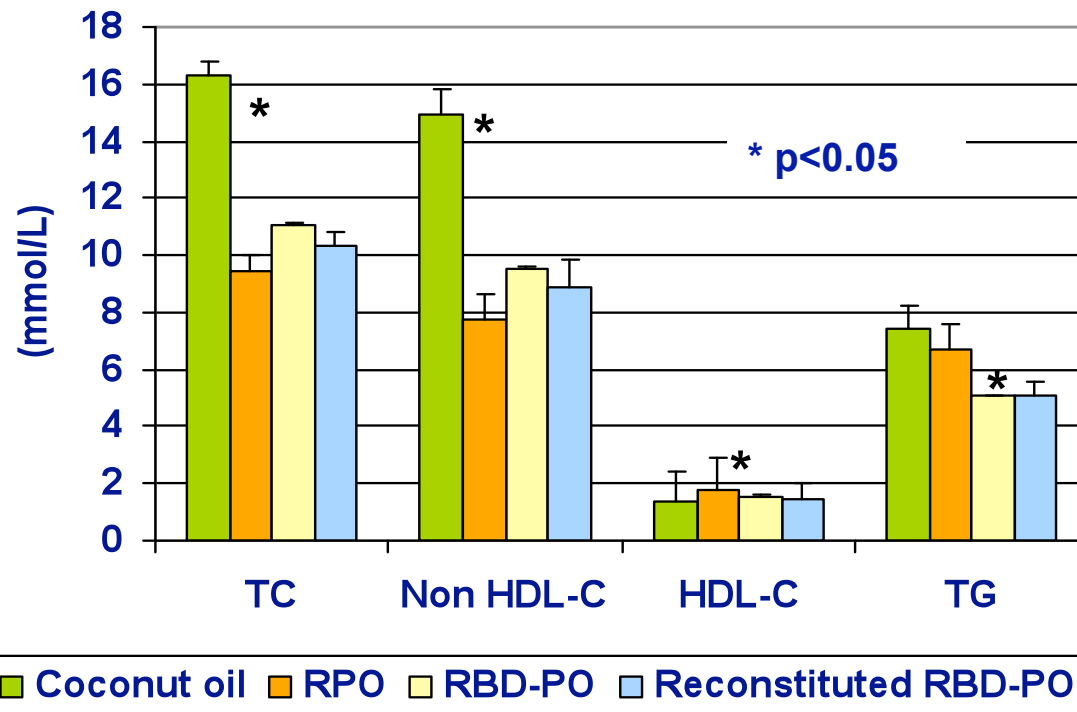
***Reconstituted RPO = RBD-PO supplemented with antioxidant components of RPO

Wilson T.A. et al. (2005) J. Nutr. Biochem. 16:633-640

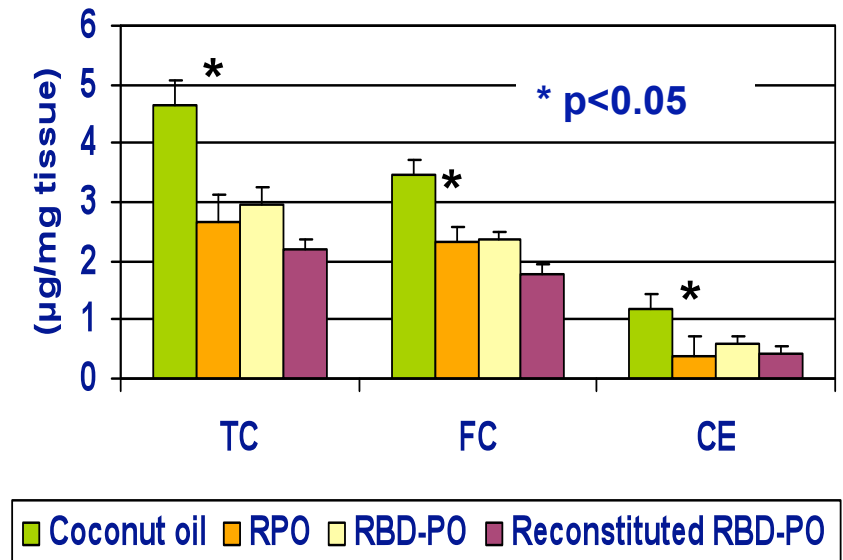


Effect of different palm oil preparations and coconut oil on plasma cholesterol level and aortic cholesterol accumulation in hypercholesterolemic hamsters

Plasma cholesterol level



Aortic cholesterol level



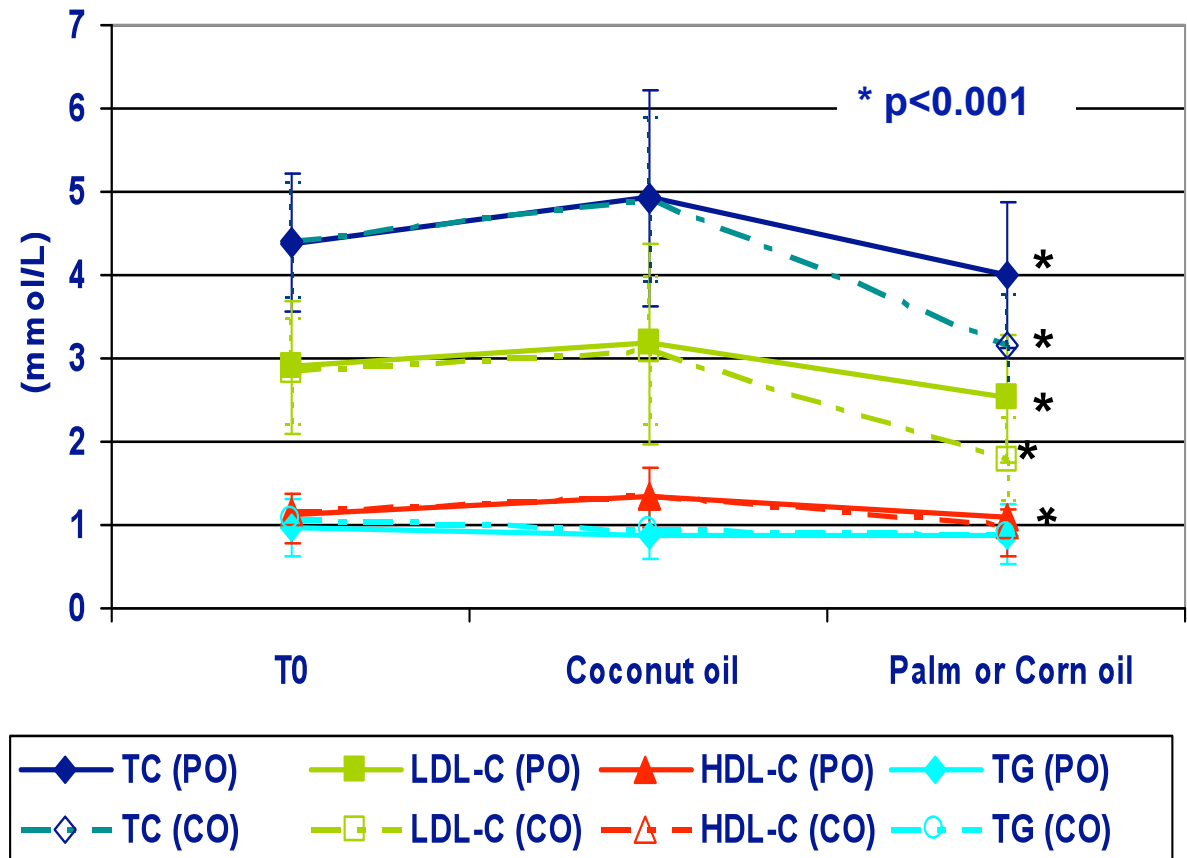
Wilson T.A. et al. (2005) *J. Nutr. Biochem.* 16:633-640





Effect of a palm-oil diet on plasma lipids in Malaysian volunteers (n=26-27)

	Palm	Corn %	Coconut
SFA	45.6	30.4	75.1
12:0	1.0	1.0	36.8
14:0	1.6	0.9	16.0
16:0	37.6	22.2	14.5
18:0	4.9	5.2	3.6
MUFA	42.7	33.8	11.7
18:1	41.9	32.7	11.0
PUFA	11.4	35.6	2.8
18:2	10.9	35.2	2.7
18:3	0.5	0.4	0.1

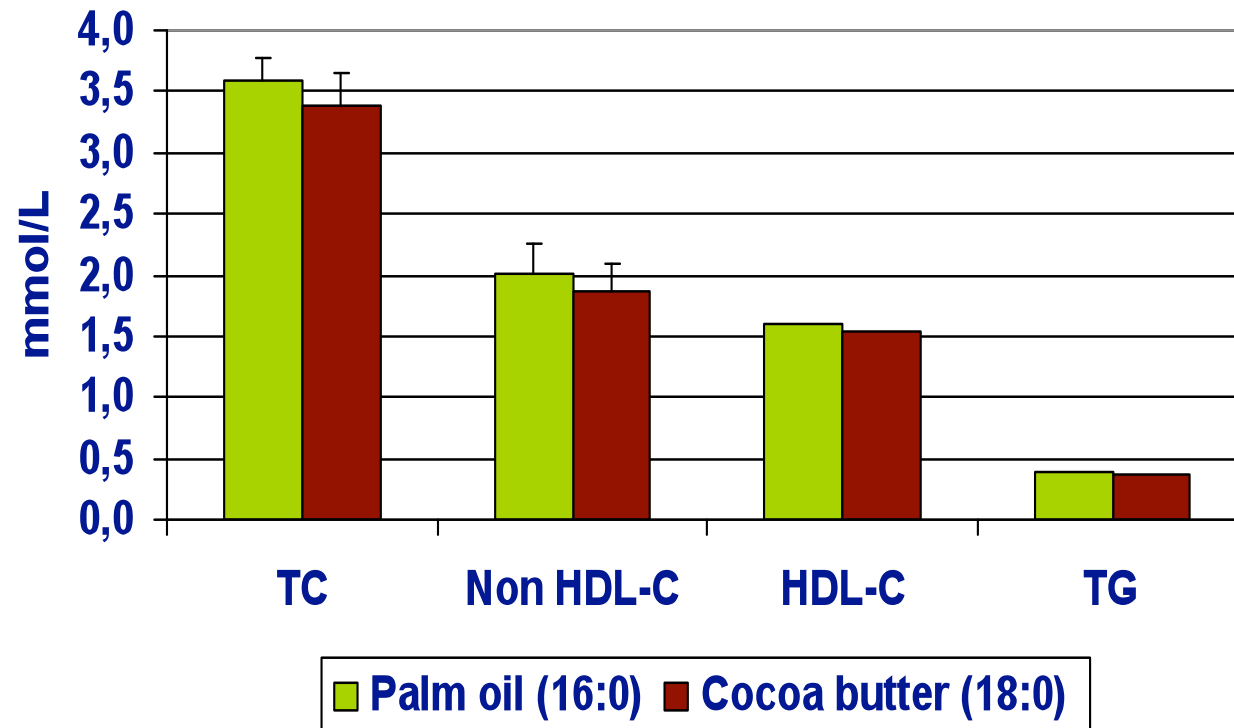


Ng TKW et al. Am J Clin Nutr 1991;53:1015S-20S.



Comparison of palm oil and cocoa butter effects on plasma cholesterol level in Cynomolgus Monkeys Fed Diets with Adequate Levels of Linoleic Acid

	Palm oil diet	Cocoa butter diet
	g/100 g	
SFA	33.3	33.0
12:0	0.06	0
14:0	0.50	0
16:0	29.0	16.0
18:0	4.1	17.0
MUFA	32.0	31.0
PUFA	34.3	35.3



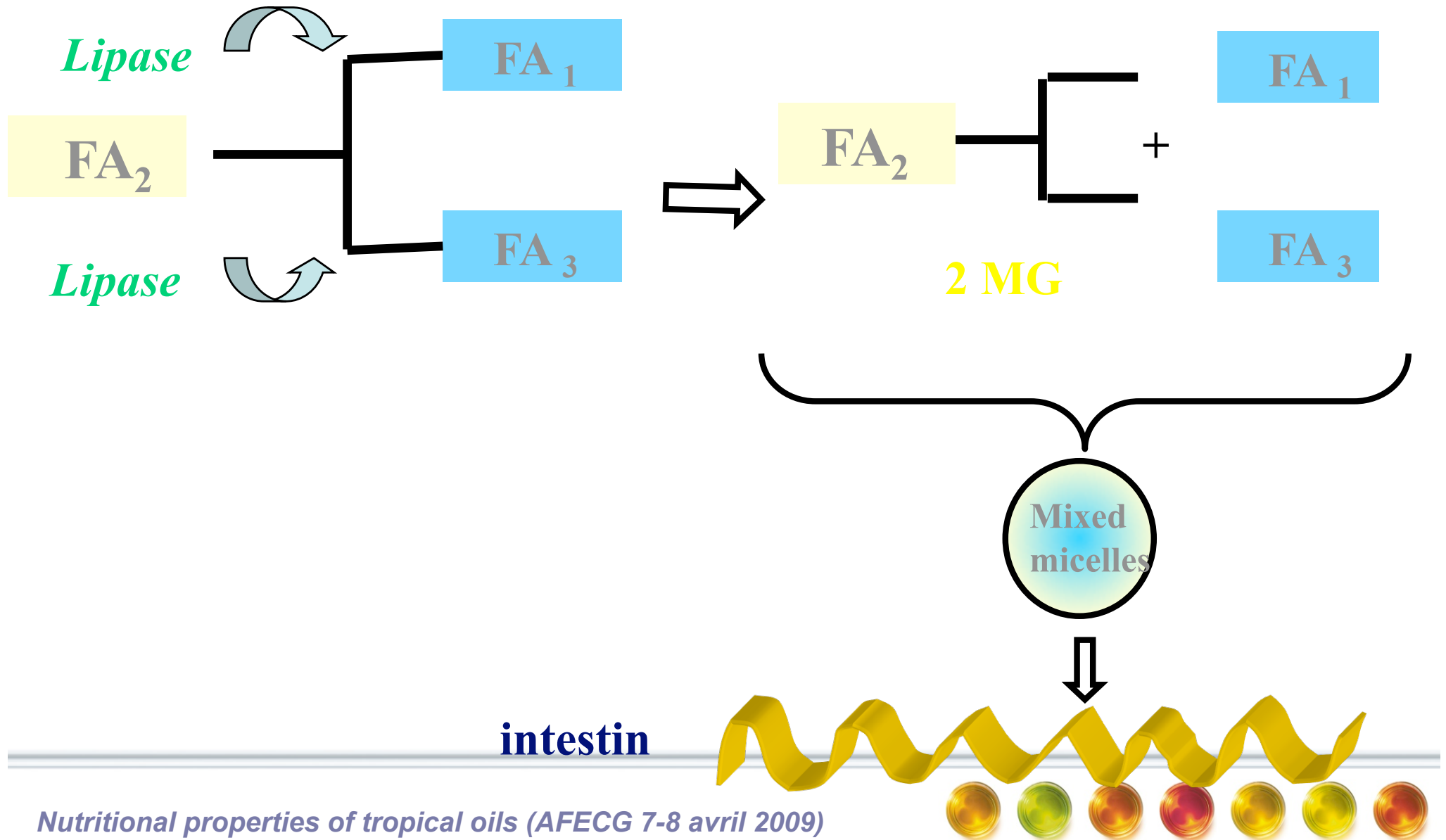
Exchange of 16:0 for 18:0, does not affect the plasma lipid profile, when diet contains adequate PUFA amount

Gupta VS et al., *J. Nutr.* 131: 2115–2120, 2001.

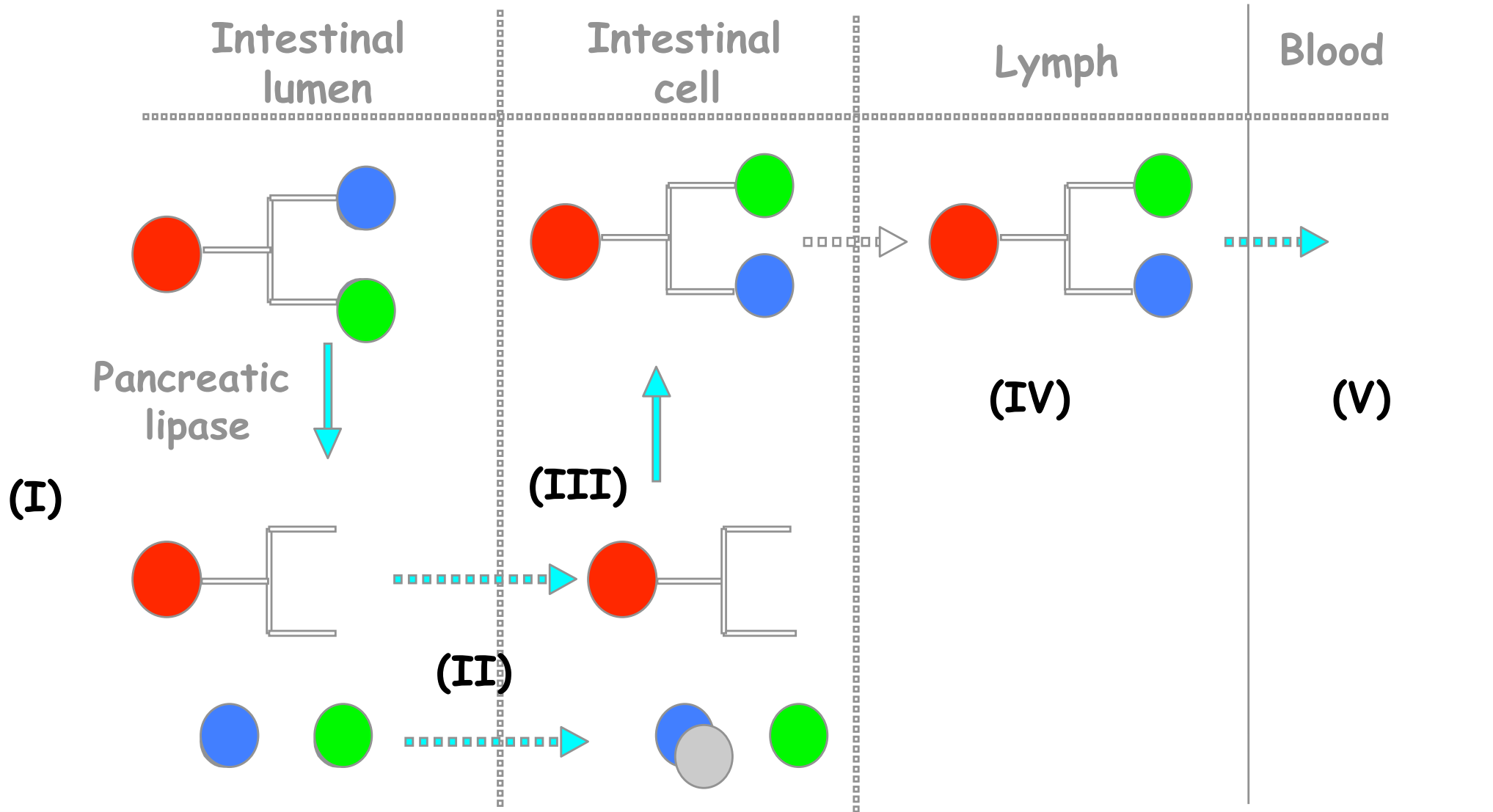


Lipid Digestion

Particularity of fatty acid in sn-2 position



Fatty acid digestion





Influence palmitic acid position in dietary triglycerids on plasma lipids

	Diet		Plasma Triglycerids		cholesterol esters
	% total	% <i>sn</i> 2	% total	% <i>sn</i> 2	% total AG
Breast milk	30,7	60.0	27,6	50,6	26,8
Palm oil	27,0	5.4	25,7	14,4	14,2
Milk formula	29,6	78.7	28,1	44,2	24,2

Innis SM *et al.* 1995



Palmitic acid position and atherosclerosis

	Oils	16:0 / %sn2	Serum total Cholestérol ^a	atherosclerosis ^b
Kritchevsky <i>et al</i> 1998 (2 months)	Beef tallow	24 / 90	926	2.22*
	Beef tallow-rand.	24 / 33	834	1,10
Kritchevsky <i>et al</i> 2000 (5 months)	SOS	6.3 / 1.4	328	1,35
	SSO	5.3 / 1.1	272	0,97
	POP	21.9 / 4.4	308	0,83
	PPO	22.3 / 29.3	415	1.8*

^a : mg / dl ; ^b : severity of athero. : 0 à 4 scale ; * : p<0.05

➔ atherosclerosis risk when fats bear palmitic acid at the sn-2 position.



Effect of positional distribution of fatty acids in palm oil on *platelet aggregation*

	Position	14:0	16:0	18:0	18:1	18:2	18:3
<i>g/100 g total fatty acids</i>							
Palm oil	2	1.0	23	1.7	55	17	0.12
Native	1,3	1.6	58	5.5	27	5	0.30
Interesterified	1,2 or 3	1.4	46	4.2	36	9.1	0.24

	Palm oil		
	Native	Interesterified	<i>P</i>
Aggregation			
Thrombin, %	100 ± 0.00	277 ± 102	0.09
ADP, %	100 ± 0.00	130 ± 15	0.05

Renaud S. et al., J. Nutr. 125: 229-237, 1995.



Effects of dietary palm oil on arterial thrombosis, platelet responses

Prostanoid formation in citrated Whole blood activated with collagen (3.3 g/ml)

	Control	Palm oil	Sunflowerseed oil
TXB₂ (log ng/ml)	1.70 ± 0.07	1.55 ± 0.04*	1.64 ± 0.08
6-keto-PGF_{1α} (log pg/ml)	2.95 ± 0.03	2.99 ± 0.04	3.05 ± 0.03

* p < 0.01

dietary palm oil significantly reduced thromboxane formation, leaving production of prostacyclin unaffected



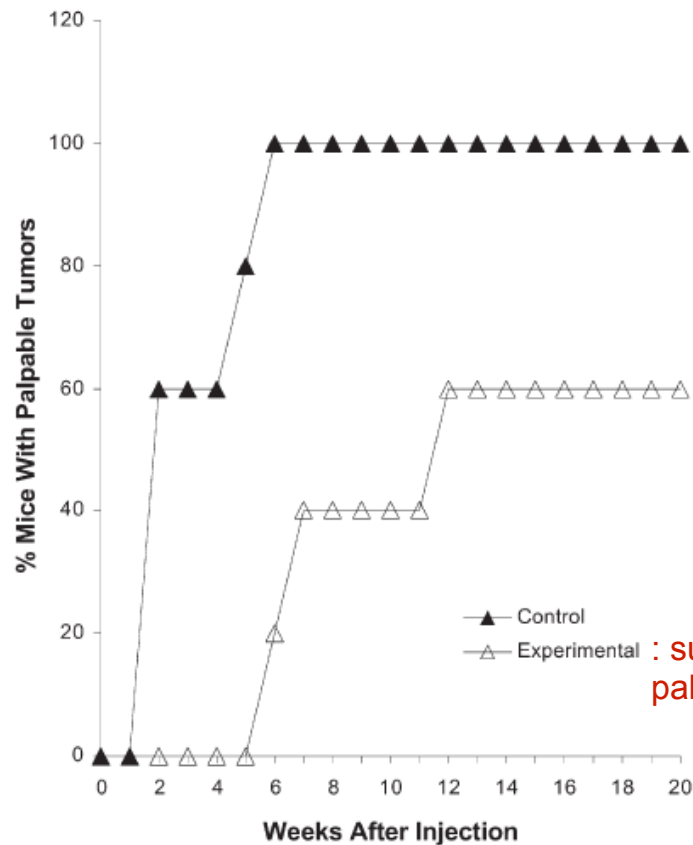
Health benefits of palm fruit oil carotenoids

- ☞ RPO in the maternal diet was shown to improve the vitamin A status of lactating mothers and their infants.
- ☞ Consumption of RPO incorporated in a sweet snack or biscuits significantly improved plasma retinol concentrations in children with subclinical vitamin A deficiency. There is evidence that if only 35-50% of the recommended daily intake for vitamin A were to be provided by RPO, it may be sufficient to prevent vitamin A deficiency (hypovitaminosis A).
- ☞ palm oil carotene is able to modulate the immune system by increasing peripheral blood NK cells and B-lymphocytes and suppress the growth of human breast cancer cells

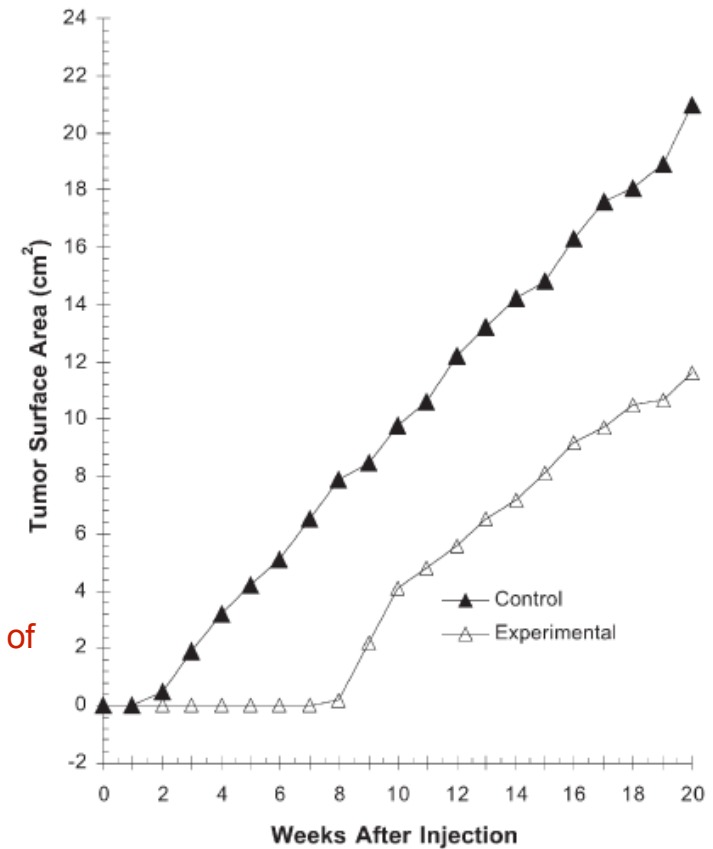




Effect of Palm Oil Carotene on Breast Cancer Tumorigenicity in Nude Mice



Experimental : supplemented with 1000 ppm of palm carotene



Animal groups	Grossly visible nodules	Micrometastases	Total metastatic incidence
Control	3/24 (12.5)	9/24 (37.5)	12/24 (50)
Experimental ^b	1/24 (4.2)	3/24 (12.5)	4/24 (17) ^c

^cSignificantly different from control group ($p < 0.05$).

Nesaretnam K, *Lipids* 37, 557–560 (June 2002).



Fatty acid intake of French population

	SU.VI.MAX study (1995-97)	Enquête INCA (1998-99)	Transfair study (1995-96)	Aquitaine study (1996-99)	RDI
total lipids (g/j)	-	90,2	81,2	89,9	74,0
Saturated fatty acids (%)	46,0	48,3	49,4	44,8	25,0
Monounsaturated fatty acids (%)	38,0	39,2	37,3	39,4	60,0
polyunsaturated fatty acids (%)	16,0	12,4	13,3	15,8	15,0