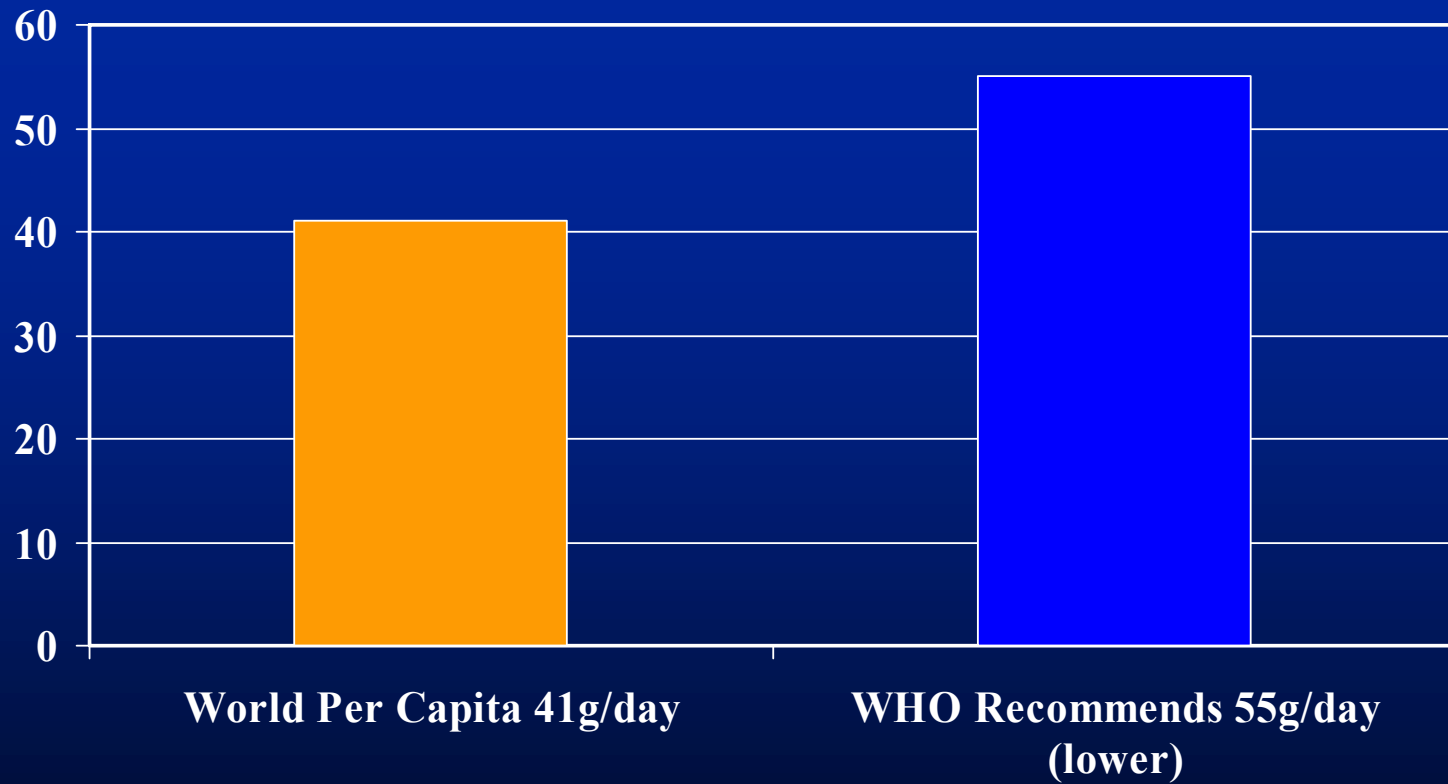


# Nutritional Benefits of Palm Oil/TFA: Issues and Opportunities for Palm Oil in the Middle East

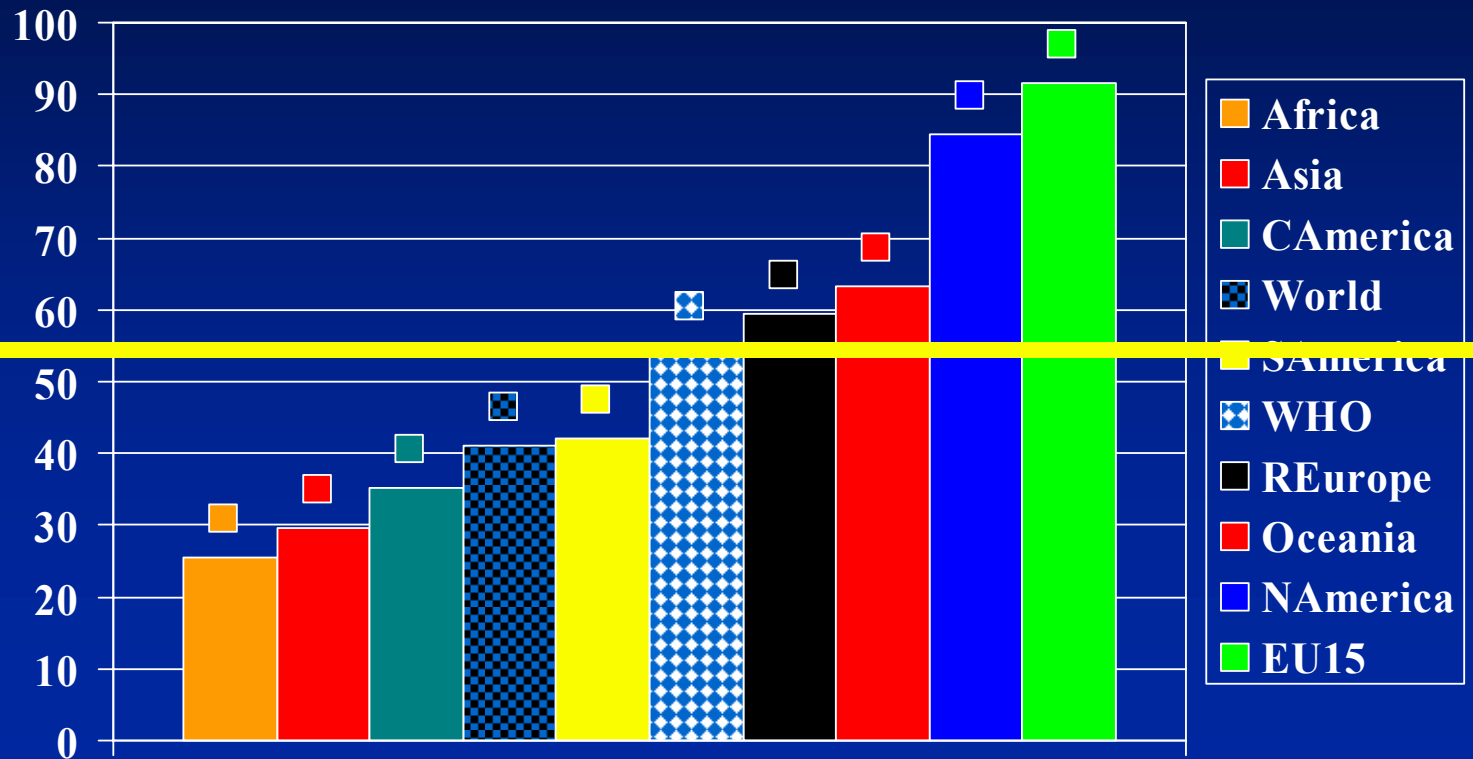
Pramod Khosla, PhD  
Dept. of Nutrition & Food Science,  
Wayne State University,  
Detroit, MI 48202

# *Fats & Oils Consumption*



*Source : FAO website*

# Major population dense centers - get insufficient fat



*Per Capita Fat Consumption : g/day*

*Regional Basis*

# Sufficiency of Oils & Fats

Oils and Fats Balance 2006 ('000 MT)

	Production	Disappearance	Imports	Exports	Net Exports / (Imports)
Malaysia	18,139	3,662	1,287	15,535	14,248
Indonesia	18,366	4,504	86	13,761	13,675
Argentina	8,222	942	17	7,374	7,357
Brazil	7,022	4,803	224	2,558	2,334
Ukraine	2,362	955	244	1,676	1,432
Canada	2,488	1,377	434	1,567	1,133
Philippines	1,533	698	268	1,084	816
Thailand	1,119	997	105	272	167
Australia	944	769	287	449	162
Colombia	867	824	237	272	35
USA	16,699	16,202	2,637	2,596	(41)
Russia	2,122	2,411	666	671	(252)
Taiwan	1,119	1,415	105	105	(296)
Nigeria	1,119	1,464	105	105	(354)
Rep of S. Africa	1,119	1,788	105	105	(699)
South Korea	1,119	1,869	105	105	(751)
Japan	1,119	2,012	105	105	(913)
Mexico	1,667	2,788	1,101	30	(1,071)
Bangladesh	199	1,318	1,102	0	(1,102)
Egypt	295	1,431	1,192	48	(1,144)
Iran	306	1,531	1,282	78	(1,204)
North Africa *	507	1,758	1,642	313	(1,329)
Turkey	1,231	2,519	1,691	323	(1,368)
Pakistan	1,666	3,312	1,750	115	(1,635)
India	9,161	13,741	4,949	299	(4,650)
China PR	19,640	27,143	7,943	418	(7,525)
EU25	18,072	26,294	9,800	1,384	(8,416)
Others	11,211	19,541	13,540	5,134	(8,406)
<b>World Total</b>	<b>149,616</b>	<b>148,263</b>	<b>55,839</b>	<b>56,042</b>	<b>203</b>

*- handful of countries are sufficient in terms of edible fat production*

Source: Oil World

\* North Africa=Algeria, Libya, Morocco, Tunisia

## *Nutritional attributes of Palm Oil/Palm Olein*

- **Variety of carotenoids (Vitamin A)**

## *"Vitamin A" activity of red palm oil*

	RE Per 100 g	Relative quality (Times <red palm oil
Red Palm Oil	30,000	-
Carrots	2,000	15
Leafy Vegetables	685	44
Apricots	250	120
Tomatoes	100	300
Bananas	30	1000
Orange Juice	8	3,750

# *Carotene Profile of red palm oil*

Phytoene	2.0%
Phytofluene	1.2%
Cis- $\beta$ - Carotene	0.8%
$\beta$ - Carotene	47.4%
$\alpha$ - Carotene	37.0%
Cis- $\alpha$ - Carotene	6.9%
$\zeta$ - Carotene	1.3%
$\delta$ - Carotene	0.6%
$\gamma$ - Carotene	0.5%
Neurosporene	Tr
$\beta$ - Zeacarotene	0.5%
$\alpha$ - Zeacarotene	0.3%
Lycopene	1.5%

6/30

*Numerous human studies showing efficacy of red palm oil in fighting Vitamin A deficiency*

## *... studies have adopted different approaches to provide Vitamin A naturally*

- Children fed traditional Indian sweets made with redPO
- School children fed biscuits baked with redPO
- School children given 5 – 10 mL redPO daily
- Cooking green leafy vegetables in redPO
  
- Also Vitamin A status improved by feeding redPO to pregnant mothers at various stages of pregnancy.
  
- Also lactating mothers

## *... Palm Oil/Palm Olein*

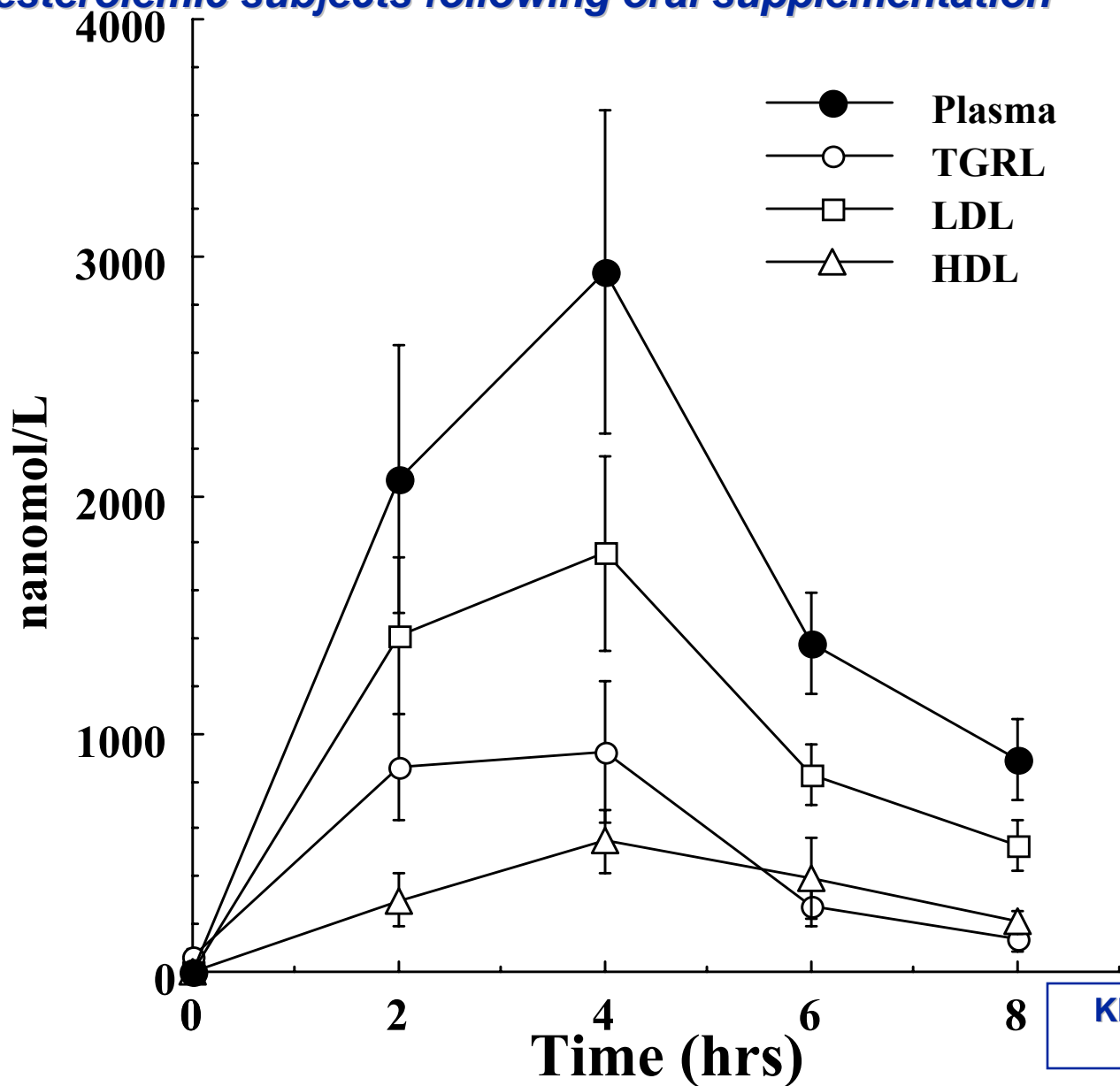
- Variety of carotenoids (Vitamin A)
- **Vitamin E (tocopherols and tocotrienols)**

## Comparison of Vitamin E Content of red palm oil & other Vegetable Oils

Oil	Tocopherols(ppm)				Tocotrienols(ppm)				Ppm T+T <sub>3</sub>
	$\alpha$ T	$\beta$ T	$\gamma$ T	$\delta$ T	$\alpha$ T <sub>3</sub>	$\beta$ T <sub>3</sub>	$\gamma$ T <sub>3</sub>	$\delta$ T <sub>3</sub>	
Red Palm Oil	152	-	-	-	205	-	439	94	890
Soyabean	101	-	593	264					985
Cornoil	112	50	602	18					782
Groundnut	130	-	216	21					367
Safflower	387	-	174	240					801
Sunflower	487	-	51	8					546

Numerous *in vitro* studies showing efficacy of tocotrienols in inhibiting breast cancer cell proliferation and decreasing neurodegeneration

***Distribution of alpha tocotrienol in plasma and lipoprotein sub-fractions in normo-cholesterolemic subjects following oral supplementation***

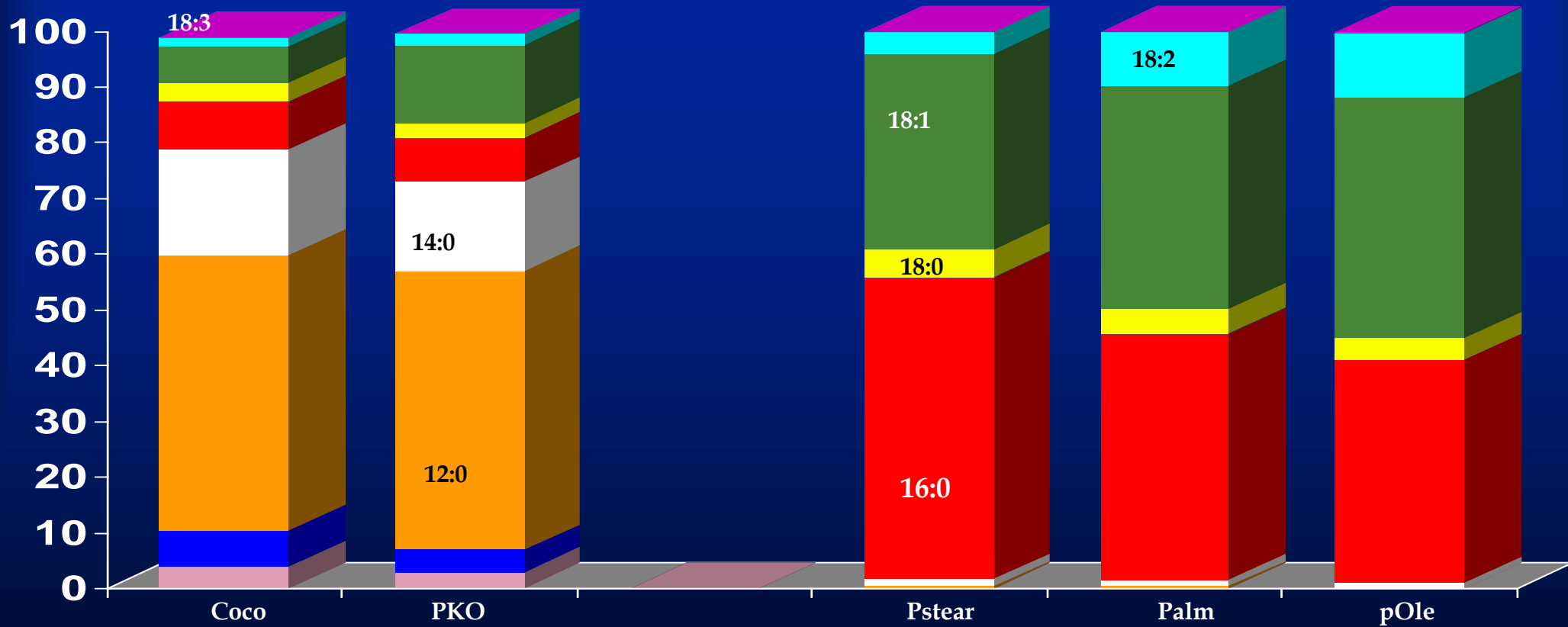


**Khosla et al Antioxid. Redox. Sig  
(2006) 8: 1059-1068**

## *... Palm Oil/Palm Olein*

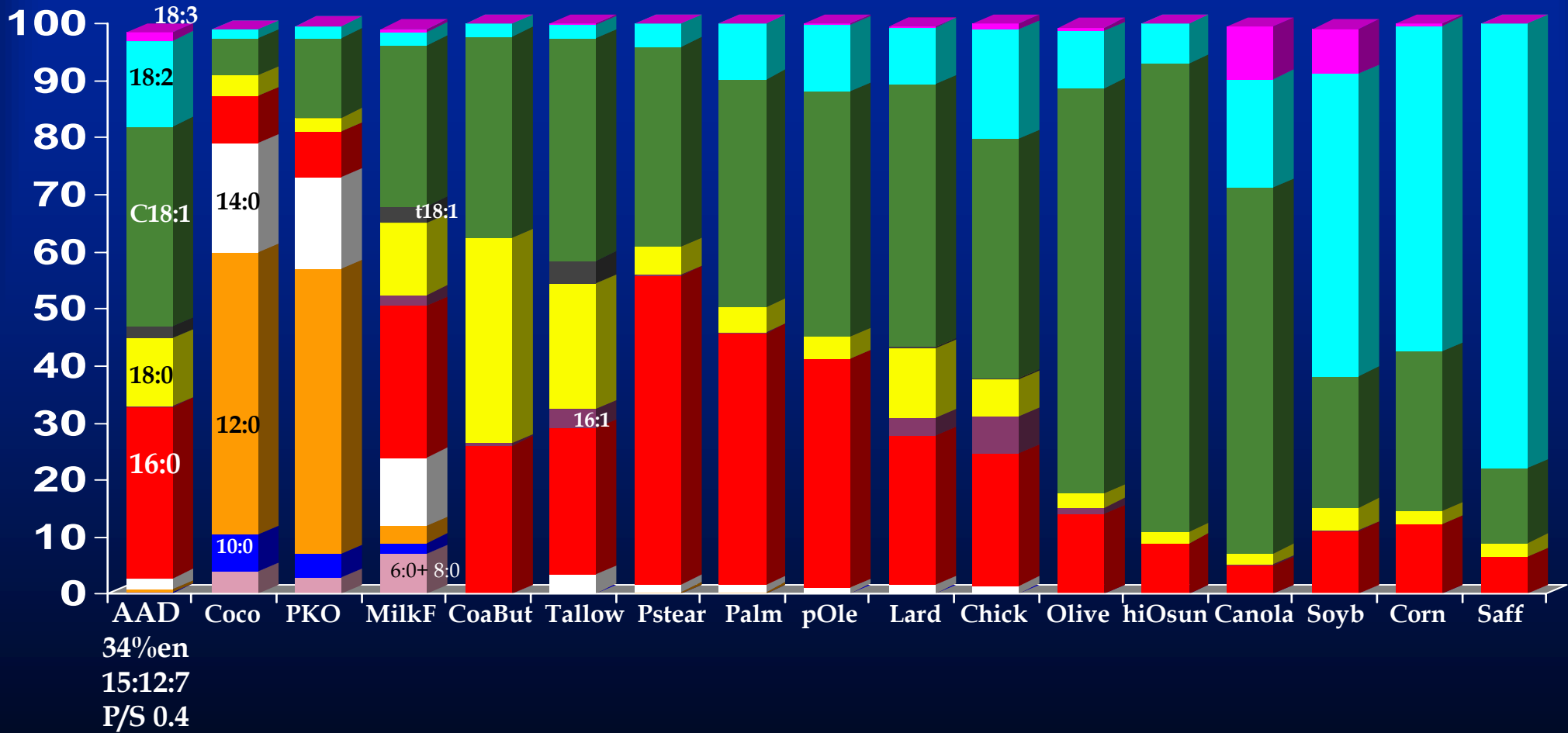
- Variety of carotenoids (Vitamin A)
- Vitamin E (tocopherols and tocotrienols)
- ..... **Fatty acid composition – replacement for trans Fatty acids**

# *Palm Oil is distinct from Palm Kernel Oil*

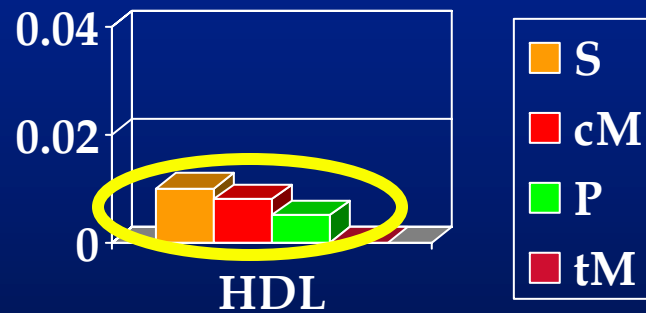
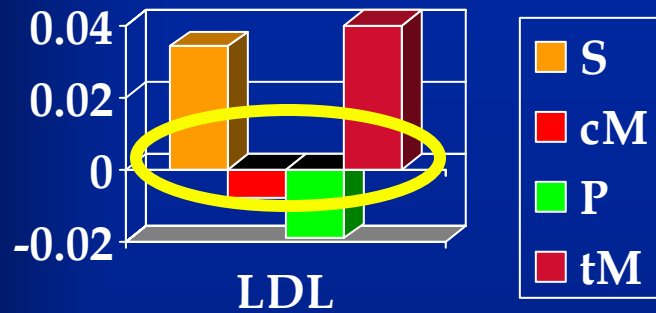


# *Dietary fats comprised of individual fatty acids - especially important for SFA*

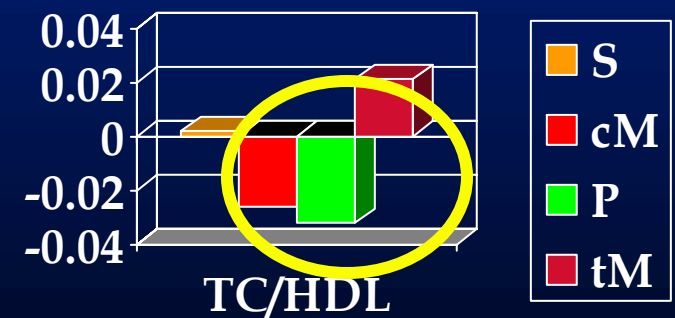
Fatty Acid Classes



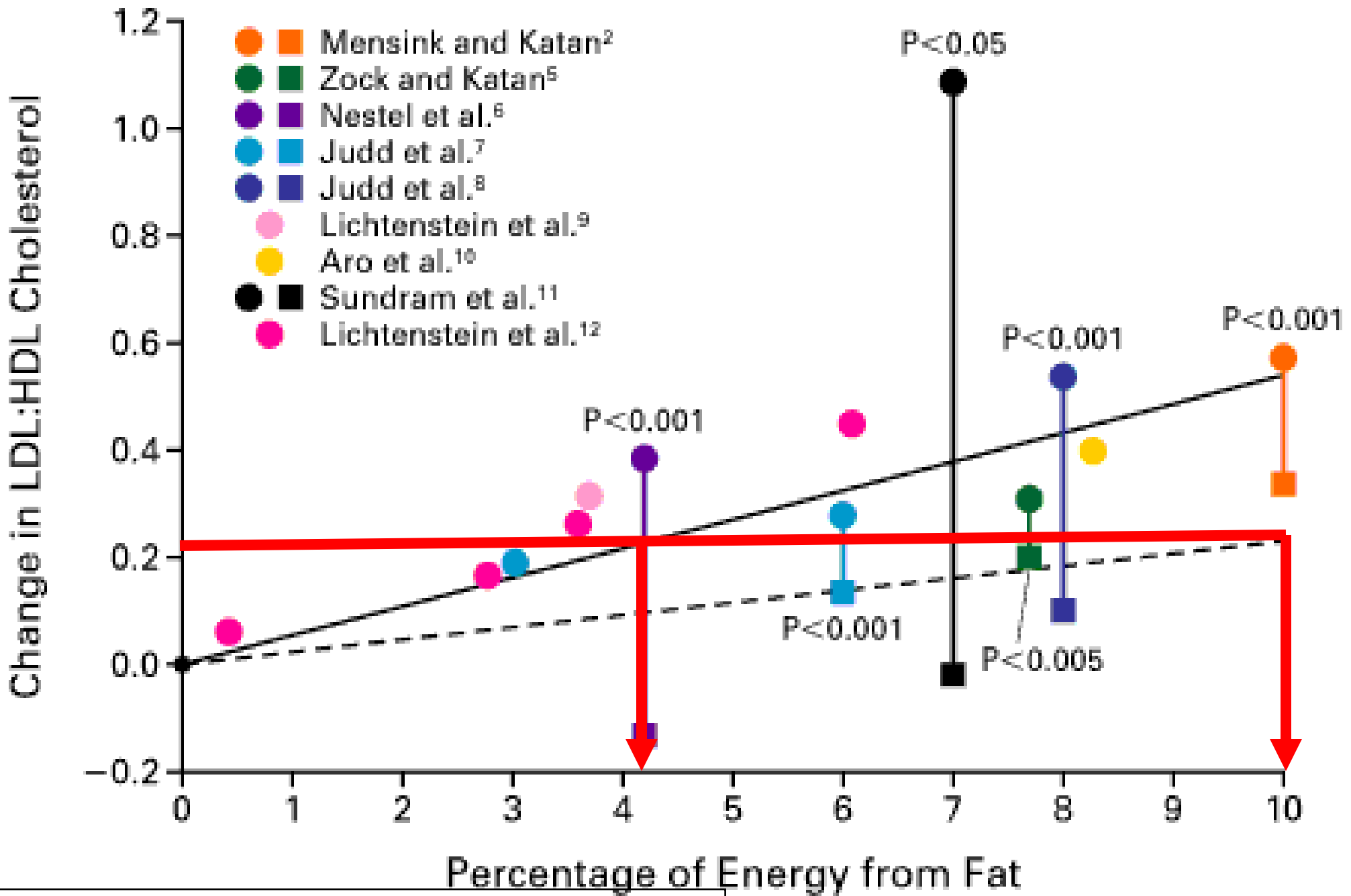
# So what are the effects of fatty acids classes on lipoprotein cholesterol?



**MUFA & PUFA best.  
Trans worse than SFA**

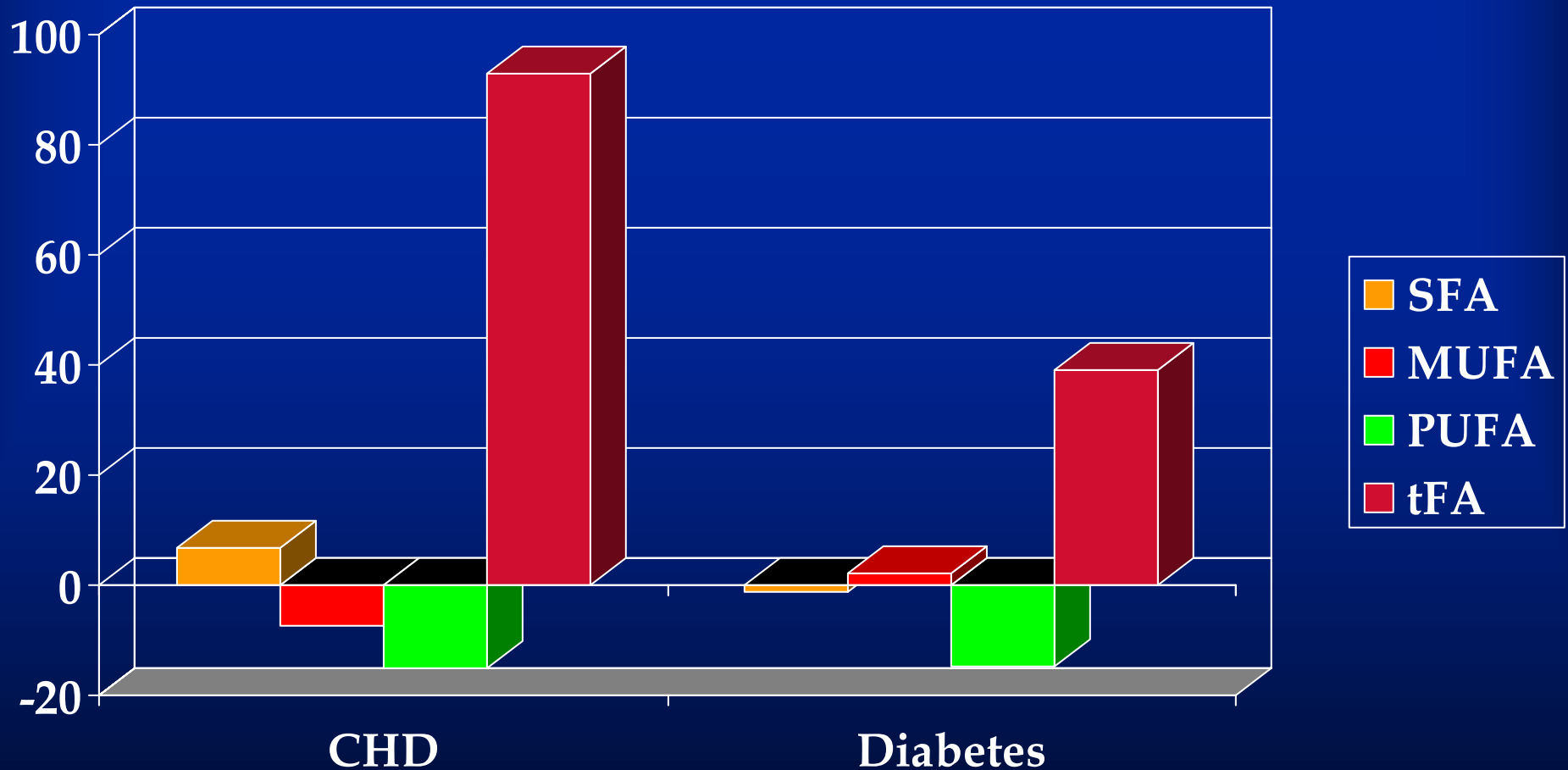


Changes shown in mmol/L for LDL and HDL. Adapted from Mensink et al Am J Clin Nutr (2003) 77: 1146-1155



Ascherio et al, (1999 N Engl J Med 340: 1994-1998)

## *Dietary Fat intake and Risk of CHD and Type II Diabetes (TIID) in Women*



*Effects of replacing 2% en from carbohydrates with trans fatty acids*

CHD data - Hu et al, (1997) N Engl J Med, 337: 1491-1499

Type II Diabetes data - Salmeron et al, (2001) Am J Clin Nutr 73: 1019-1026

## *....as a result*

- Various countries have legislation on trans FA
- Denmark, Canada, US and UAE
- Sheikh Khalifa Medical City
- ...so seeking viable alternatives

- Since trans are **twice** as potent as SFA – an **equal** replacement of trans with SFA (e.g. 1 g with 1 g) will **improve** lipids and decrease risk
- .. further **improvement** with unsaturated oils – but functionality and supply concerns
- **Conservative Recommendation:** Eliminate trans but ensure that the total SFA + trans content of original formulation is not exceeded by total SFA in new formulation
- Original 3 g SFA + 2g trans. New 5 g SFA or less
- Replacing trans with SFA will improve the scenario
- Palm oil appears to be an ideal and viable alternative

**TRANS  
FAT** | REPLACEMENT  
ROUNDTABLE

**Moderator**

Dennis Bier, M.D.

*Professor of Pediatrics, Baylor College of Medicine*

**Participants**

Margo A. Denke, M.D.

*Clinical Professor of Medicine, University of Texas Health Science Center, San Antonio*

Joseph Judd, Ph. D.

*Former Research Leader, Diet and Human Performance Laboratory, Beltsville Human Nutrition Research Center, USDA Agricultural Research Service*

Richard O'Brien

*Industry Consultant, Author, "Fats and Oils Formulating and Processing for Applications"*

Fran Seligson, Ph. D.

*Independent consultant and Associate Professor in the Nutrition Department at Penn State*

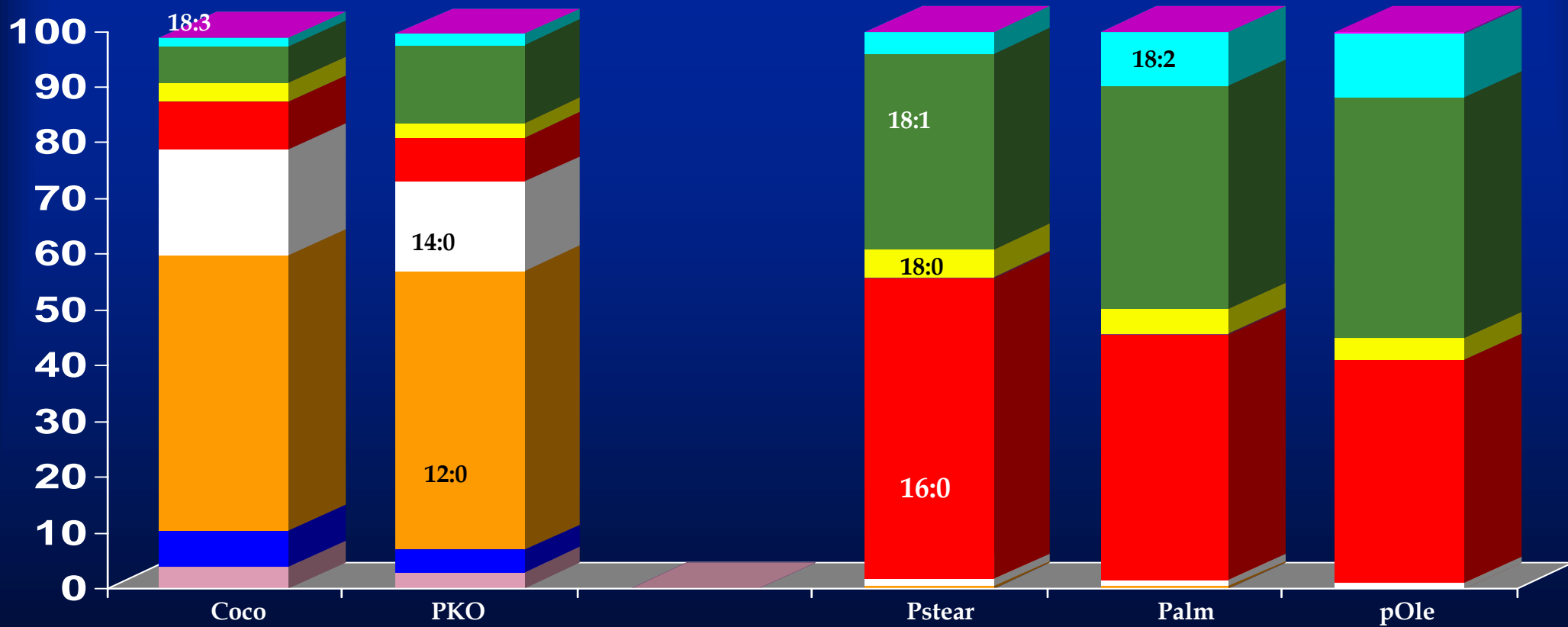
Howard Weintraub, M.D.

*Co-Clinical Director, Lipid Treatment and Research Center, New York University Medical Center, Clinical Associate Professor of Medicine*

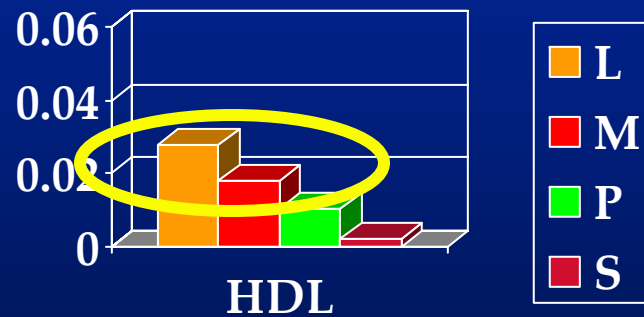
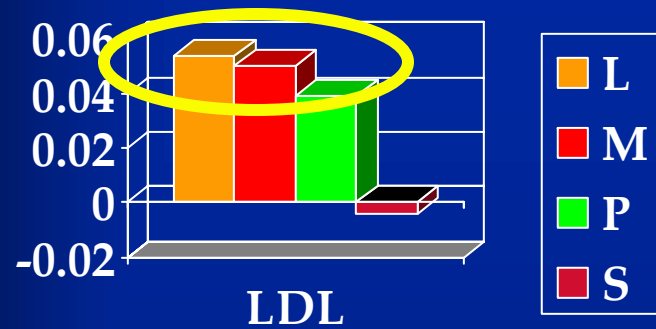
**Palm Oil "reasonable" replacement for trans fats**

- What about the saturated fat content of palm oil?

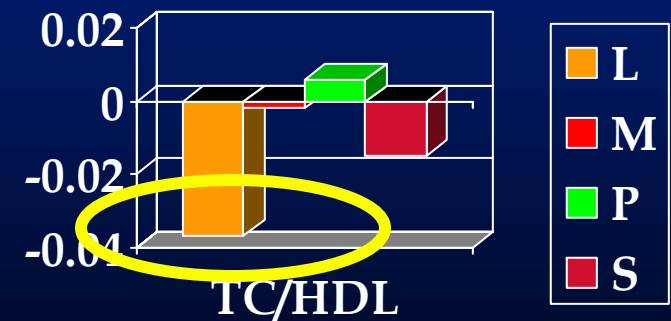
# *Major saturated fatty acid in palm oil is palmitic acid*



# Effects of individual SFA on lipoprotein cholesterol



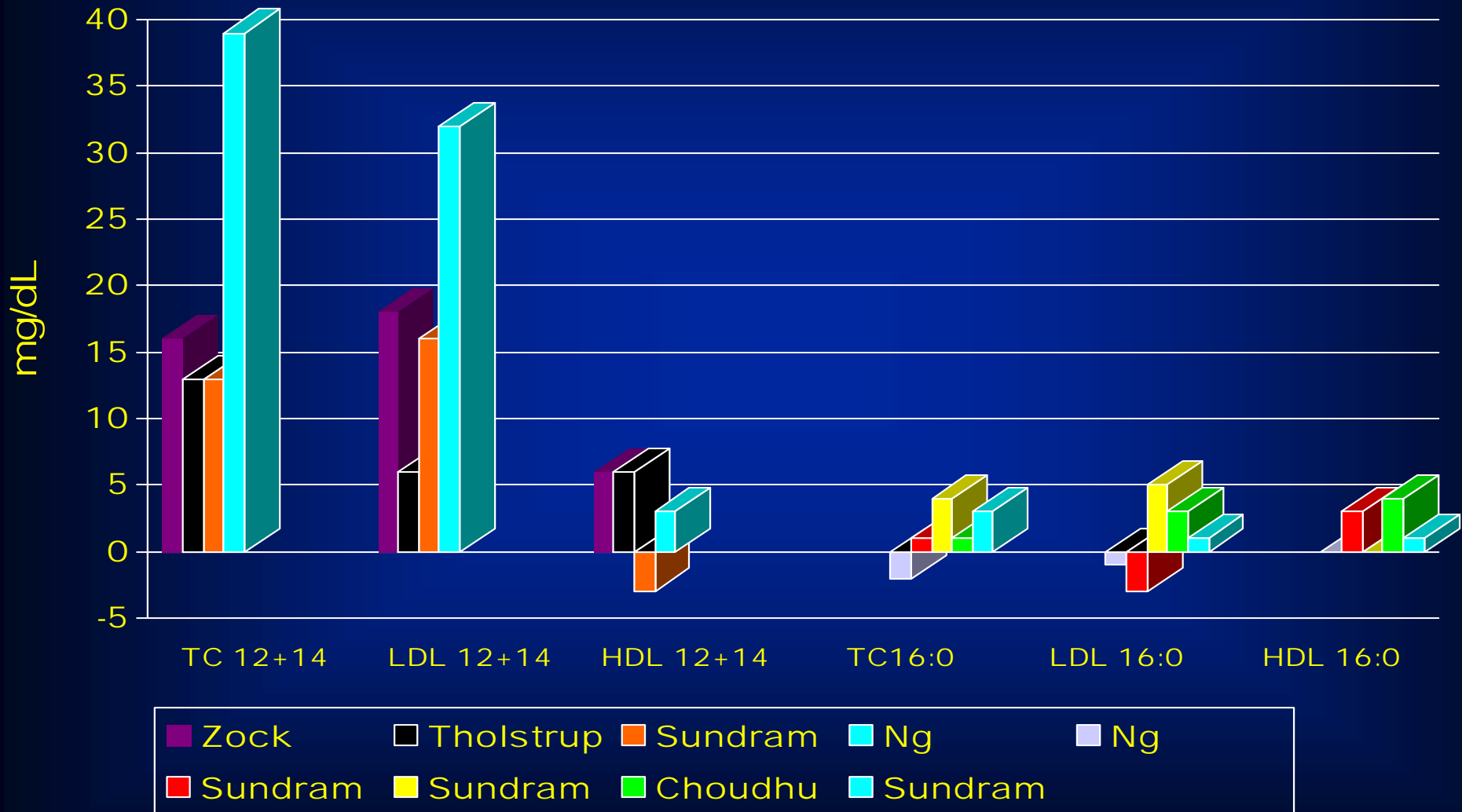
*16:0 no effect*



Changes shown in mmol/L for LDL and HDL. Adapted from Mensink et al Am J Clin Nutr (2003) 77: 1146-1155

# Saturated Fatty Acid Effects on Lipoproteins

As A Function of Fat Dietary Energy %



Compared to L + M, palmitic has negligible effects on TC

## *Threshold hypothesis*

- 14:0 and 18:2 key factors
- 14:0 raises TC (linear), 18:2 lowers TC (non-linear)
- Threshold level of 18:2 (5-6% en?)
- 16:0 becomes important as LDLr activity decreased

(Hayes & Khosla, (1992), FASEB J., 6, 2600-2607)

- More extensive analyses in gerbils (>50 diets)
- Confirmed 14:0 and 18:2 key factors
- Threshold level of 18:2 (4-5% en?)
- 16:0 cholesterolemic with increasing depression of LDL receptors

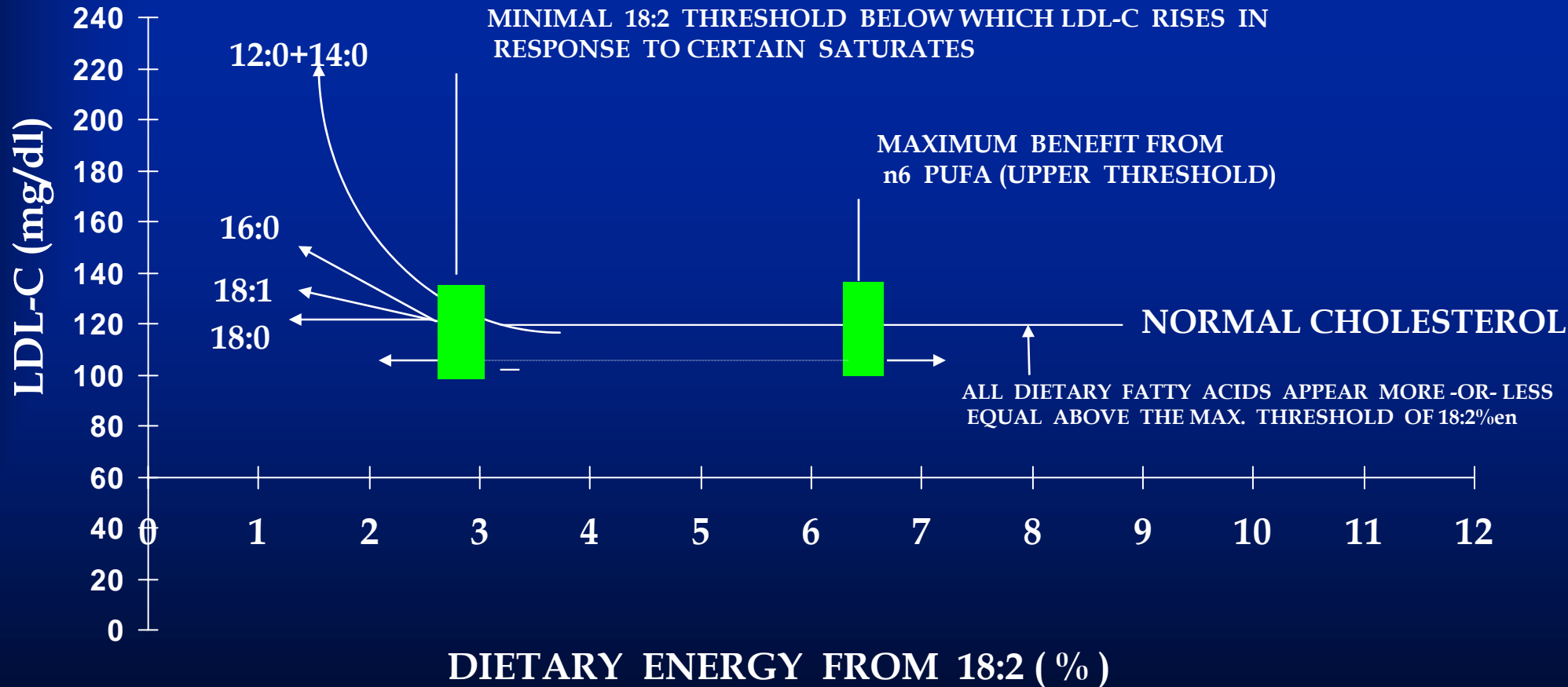
(Pronczuk, Khosla & Hayes, (1994), FASEB J., 8, 1191-1200)

- Similar story in hamsters

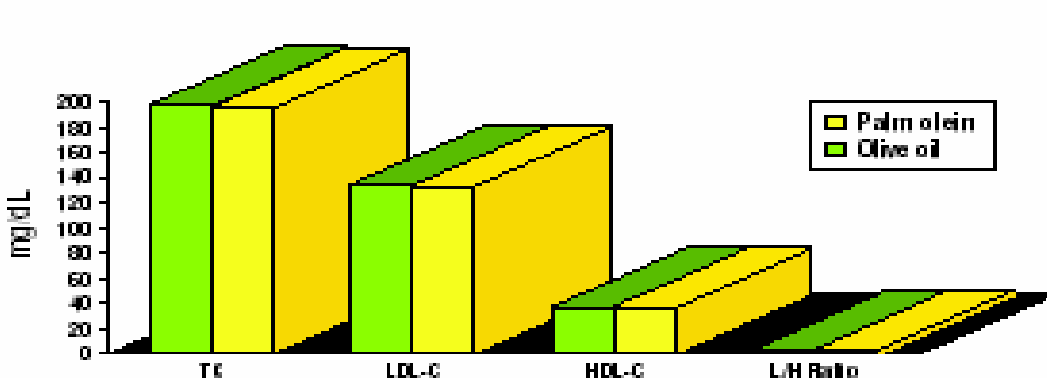
(Hayes, Pronczuk & Khosla, (1995), J. Nutr. Biochem., 6, 188-194)

**Furthermore, with adequate 18:2 in the diet, palmitic can appear “neutral’ like oleic acid**

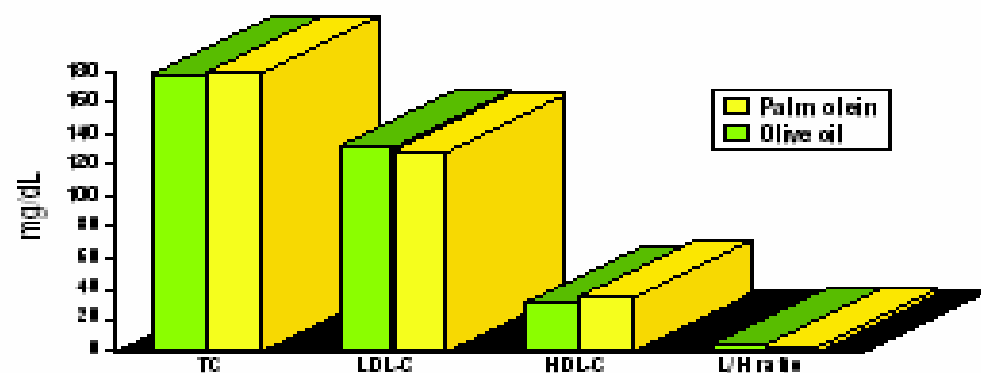
# PUTATIVE RELATIONSHIP BETWEEN THE DIETARY 18:2 THRESHOLD AND LDL-C IN HUMANS



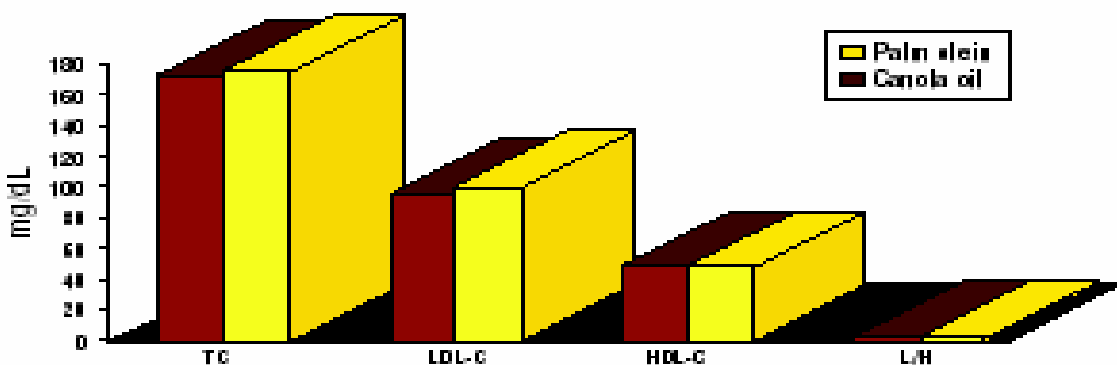
# Palm olein reduces cholesterol as effectively as olive, Canola and rapeseed oils



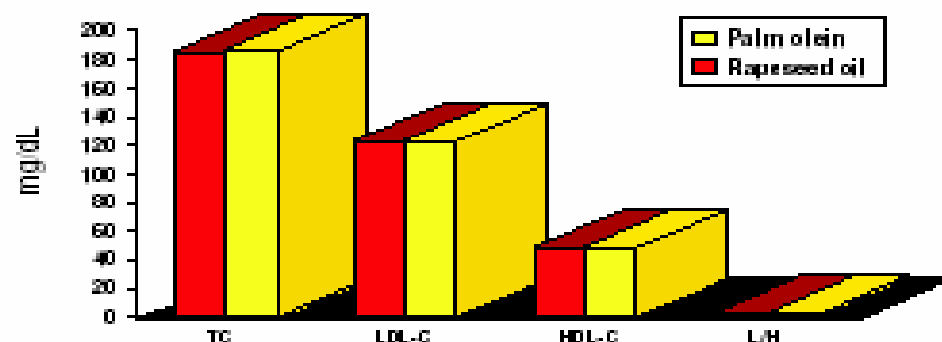
Diets enriched by palm olein or olive oil showed identical plasma cholesterol response in humans.  
*Ng et al. (1992) J. Am. Coll. Nutr.*



Diets enriched by palm olein or olive oil showed identical plasma cholesterol response in humans.  
*Choudhury et al. (1995), Am. J. Clin. Nutr.*

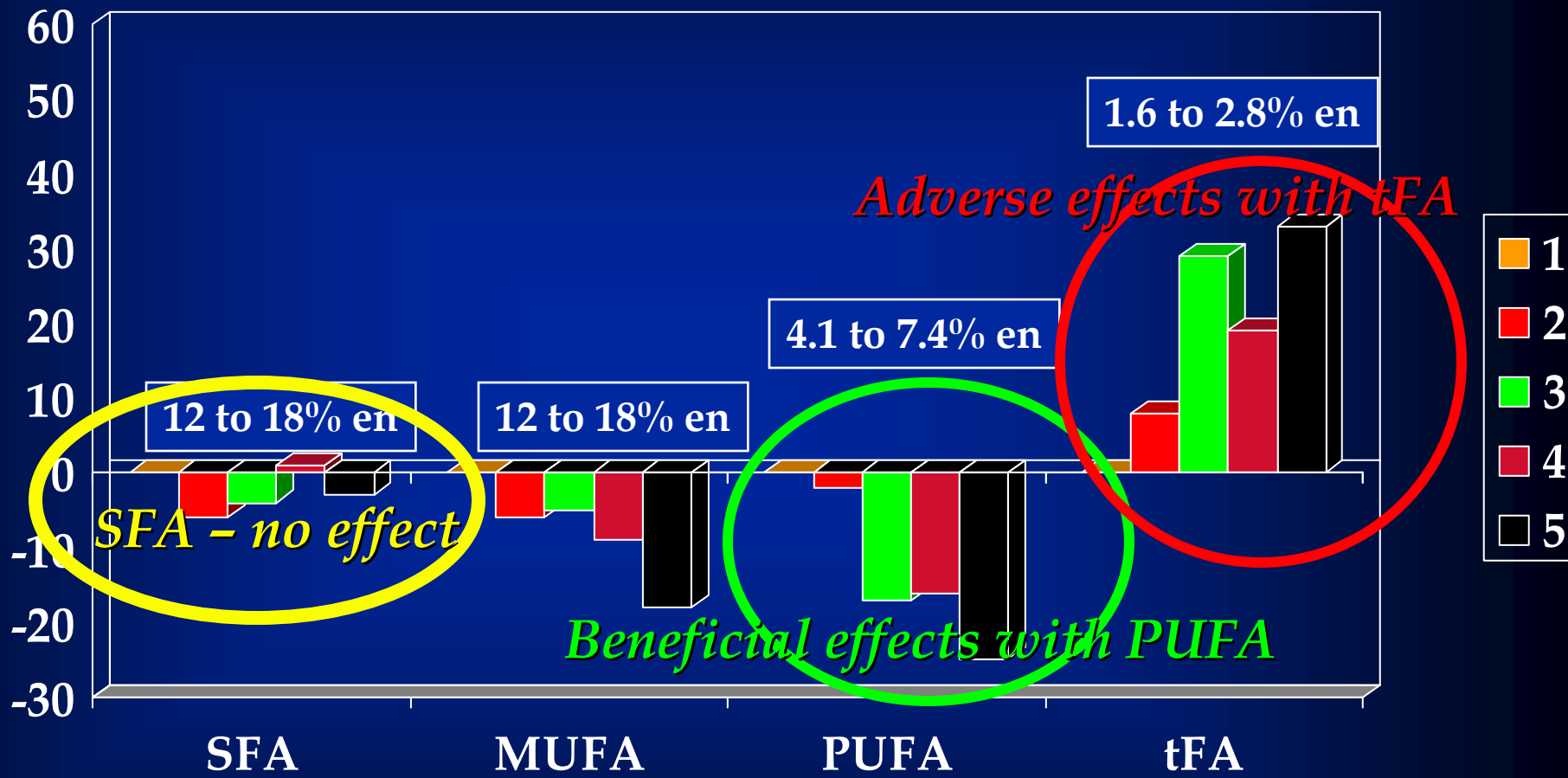


Palm olein or canola oil results in similar beneficial effects on plasma cholesterol.  
*Sundram et al. (1995), J. Nutr. Biochem*



Palm olein or rapeseed oil results in similar beneficial effects on plasma cholesterol.  
*Sundram et al. (1997) J. Nutrition*

*The importance of adequate linoleic acid is highlighted by 20 year follow-up data from the Nurses Health Study Relative risk of CHD based on quintiles of dietary fatty acid intake (Multivariate analyses)*

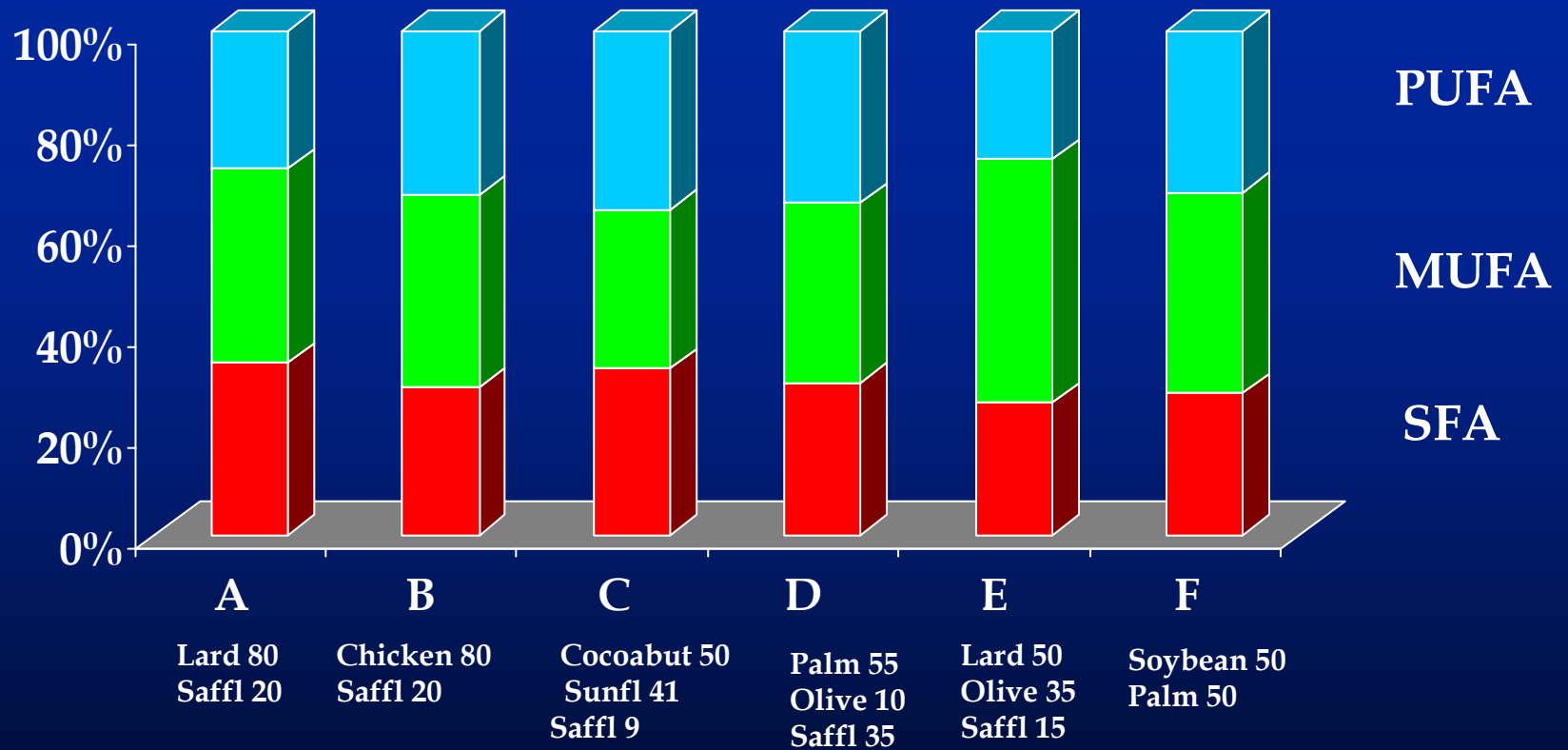


from Oh et al (2005) Am J Epidemiol, 161: 672-679

# *How much palm olein can be incorporated into the diet?*

% calories from SFA	% calories from total fat				
	20	25	30	35	40
5	54	43	36	31	27
6	65	52	43	37	32
7	76	61	51	43	38
8	87	69	58	49	43
9	97	78	65	56	49
10	100**	87	72	62	54

# Blending of oils/fats ... ..



# *Summary*

Palm Oil and its products – serve a multitude of nutritional needs

Adequate supply makes palm oil the important player on the global stage

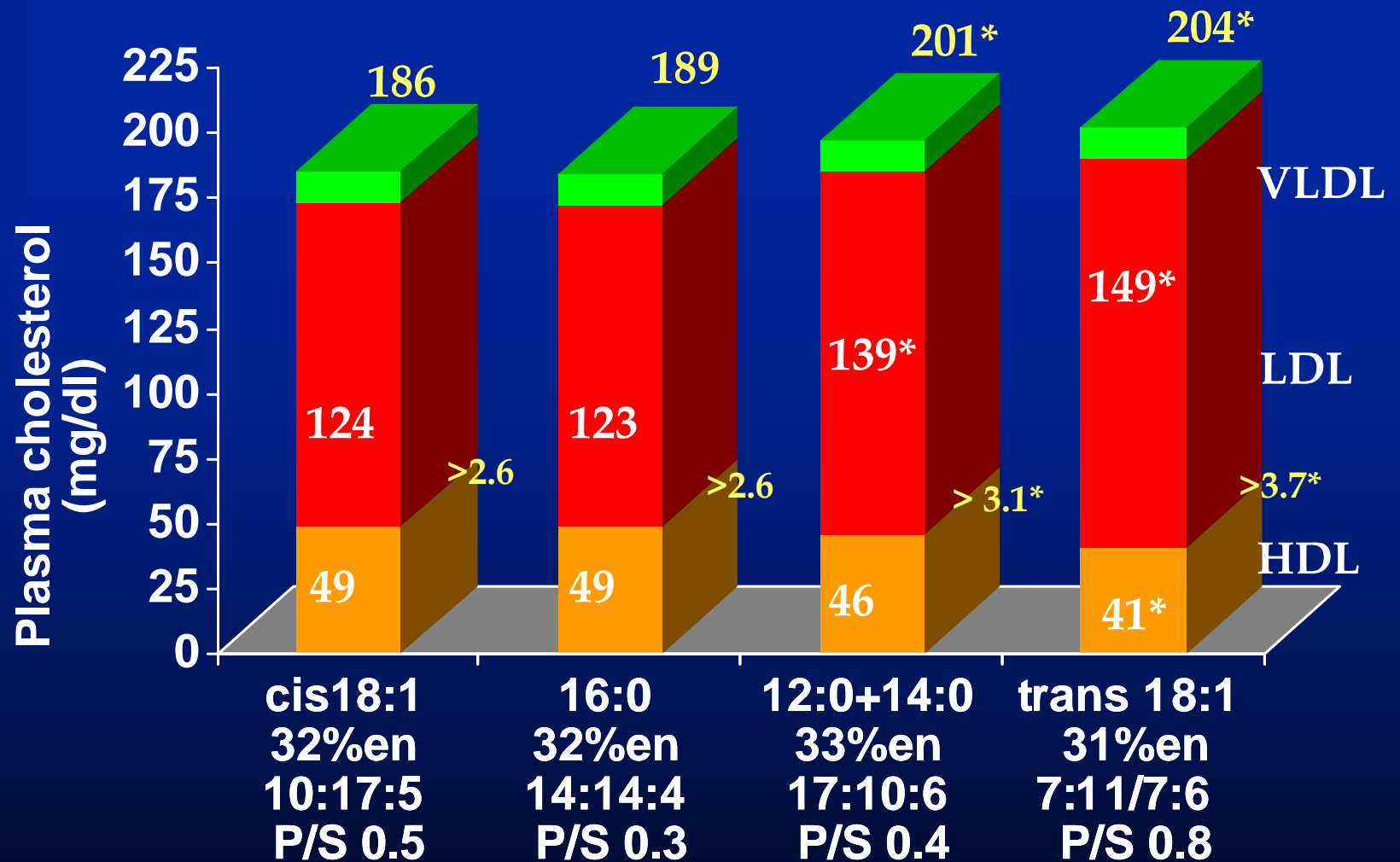
Natural fatty acid profile of palm eliminates need for hydrogenation – so ideal for trans fat-free formulations

# Features of Palm Based Margarine

- Natural semi-solid consistency hence no Hydrogenation required (TFA Free)
- Vegetable Oil, Cholesterol Free
- Contains Natural Vitamin E
- Fine & Stable Crystallizes in the beta prime form
- Cost effective

COMPARISON BETWEEN *cis* 18:1, 16:0, 12:0+14:0,  
18:1 IN NORMOLIPEMIC HUMANS

AND *trans*



# Synergy of Blended Oils (1)

## The synergy of Palm Oil and Soybean oil

- A formulation to meet the American Heart Association (AHA) Step-1 recommendation for dietary fat consumption
- The claim – “PATENDED BLEND TO HELP IMPROVE CHOLESTEROL RATIO”
- The blend
  - 50% palm oil
  - 50% liquid oils **including soybean and canola oils**
- **Met AHA recommended** composition
  - 1:1:1 ratio of saturated, monounsaturated and polyunsaturated fatty acid composition

# Synergy of Blended Oils

- The blend of palm oil, soybean oil and canola oil is marketed commercially in USA and Malaysia under the Smart Balance Brand

- The ideal benefit
  - Increasing HDL-cholesterol
  - Lowering LDL-cholesterol
- A positive synergy with up to 50% palm

