

# Breakthrough Discoveries in Palm Oil Nutritional Studies

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# OUTLINE OF PRESENTATION

- **Why we need fats in our diet**
- **MPOB's nutrition research results**
- **Current views on Sat Fats**
- **Sn2 Hypothesis**
- **Phytonutrients-Antioxidants**
- **Summary**

# Function of Fats

- Provides a concentrated source of calories
- Provides the essential fatty acids (EFA)
- Carrier for fat soluble vitamins (A,D,E,K)
- Enhances the palatability and satiety value of food
- Essential constituent of nervous tissue
- Assistance in forming the structure of foods



# Direction for Food and Nutritional Research

- 85% of world's palm oil production is used as *food*
- *Nutritional research* is a major thrust area for MPOB
- Positioning palm oil as a superior functional and nutritive oil is our *goal*



# Nutritional Research Programme

## Three main focus areas

- Effect of palm oil and its components on CHD risk
- Effect of palm oil on carcinogenesis
- Nutritional effects of the micronutrients in palm oil i.e. tocotrienols, carotenoids and palm water soluble phenolics, CoQ<sub>10</sub>, squalene and sterols

# Nutritional Research at MPOB

- Great strides have been made over the last 25 years in elucidating a number of the health benefits of palm oil and its fractions
- This has resulted in –
  - over 200 publications in high impact peer reviewed journals
  - collaborative projects undertaken at centres of excellence both local and abroad.

# 190 RESEARCH PROJECTS (1983 - 2010)

## REGIONAL DISTRIBUTION OF PROJECTS

	CHD	Palm Vitamin E	Carcinogenesis	Red Palm Oil	Palm Flavonoids	Other Studies	Total
USA / Canada	39	24	10	4	-	3	80
Europe	6	3	-	1	-	1	11
Australia	11	4	-	-	3	-	18
Asia/ Midle East	12	-	-	3	-	-	15
Africa	4	-	-	6	-	-	10
Malaysia - MPOB - Others	13 6	9 10	8 4	1 -	3 -	2 -	36 20
<b>Total</b>	<b>91</b>	<b>50</b>	<b>22</b>	<b>15</b>	<b>6</b>	<b>6</b>	<b>190</b>

## **MPOB Funded Research Findings Published in Journals**

1.	American Journal of Clinical Nutrition 1991	18
2.	Nutrition Research 1992	22
3.	United Nations Univ Food & Nutrition Bulletin 1993	7
4.	Journal of Nutritional Biochemistry 1995	6
5.	LIPIDS 1995	7
6.	Journal of Nutrition 1997	7
7.	Asia Pacific Journal of Clinical Nutrition 1997	16
8.	International Journal of Food Sciences and Nutrition	10
9.	Asia Pacific Journal of Clinical Nutrition 2002	14
10.	Asia Pacific Journal of Clinical Nutrition 2004	16
11.	Asia Pacific Journal of Clinical Nutrition 2006	15
12.	Independent Peer Reviewed Journal Publications	80
	<b>Total</b>	<b>218</b>

# Summary of International Collaborations

- King's College London, UK
- University of Maastricht, The Netherlands
- MIT
- MD Anderson Cancer Center, USA
- Michigan State University
- University of Queensland, Australia
- Ohio State University, USA
- National Institute for Food and Nutrition Research (INRAN), Rome, Italy
- Department of Primary Industries, Australia
- University College Los Angeles (UCLA)
- Texas A and M University
- CSIRO, Australia
- Brandeis University

# Results Achieved To Date

- We have successfully defended the neutrality of palm oil (palmitic acid) in its cholesterolemic effects
- Palm oil was shown to be both competitive and healthier than indigenous oils-China, India, Pakistan, Bangladesh
- Anti-cancer effect of palm oil and crude palm oil
- Anti-oxidant, anti-cancer, anti-inflammatory effects of tocotrienols, carotenoids, phenolics

# **Positioning palm oil as a safer natural alternative**

- There was a world wide movement to rid the marketplace of TRANS fatty acids
- MPOB conducted studies that positioned palm oil as the natural choice for replacing trans in the diet

## Truswell et al, *AJCN*: 1995

- Palm olein and olive oil
- Young Australians
- No difference in TC, TG and HDL-C



## Zhang et al, *J. Nutr.* 1997

- PO, SBO, GNO and Lard
- Chinese adults
- PO ↓ TC and LDL-C
- SBO and GNO had no effect on TC
- Lard ↑ TC

# Ghafoorunisa et al, *Lipids*: 1995

- Palm olein and GNO
- No difference
- 10% in Lp(a) on a PO diet

# Farooq et al, *PIPOC* Proceedings 1996

- PO, SFO, HCSO
- Pakistani adults
- PO increased HDL-C
- HCSO TG and LDL-C

# Bangladesh

- Evaluation of the nutritional properties of palm oil in a Bangladesh population
- Dr. Shah Md. Keramat Ali, University of Dhaka
- POo, SBO, MSO
- POo ↑ Total cholesterol ↑ HDL

## **Not all *Saturated Fats* are equal.**

- Fats containing 12:0+14:0 are cholesterol raising.
- 16:0 and 18:0 fats are neutral in their cholesterolemic effects
- Palm oil is mainly 16:0
- Trans fatty acids (t18:1) are worse than SFA

**The concept of eating healthy has become synonymous with avoiding dietary fat, especially saturated fats**





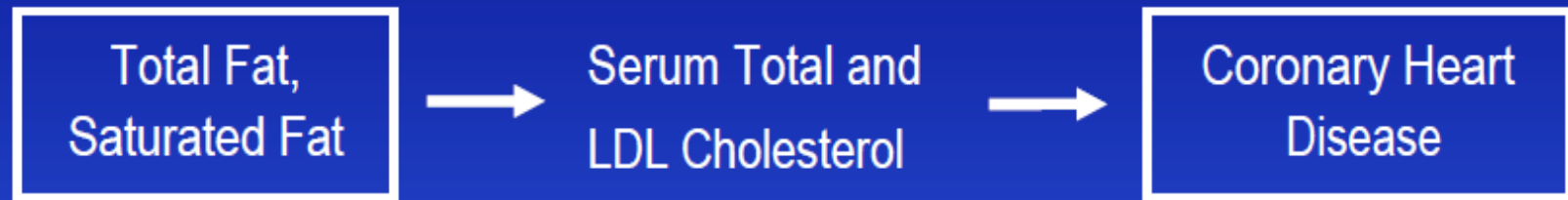
# Saturated fats and health



In the late 1950s, Keys “proved” that fats cause heart disease and saturated fats raise cholesterol levels

Often referred to as the lipids theory or diet-heart theory, has become so widely accepted that most people today take for granted that it is absolutely true

## The Traditional Diet-Heart Paradigm



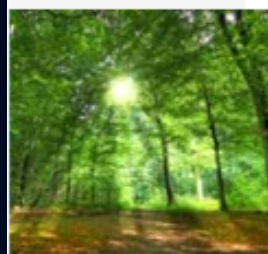




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## FSA calls for reduction on saturated fat in biscuits and cakes to help promote a healthier diet

By DAILY MAIL REPORTER  
Last updated at 8:28 PM on 26th March 2010

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Manufacturers should start making fatty food and soft drinks in single portions to help consumers choose a healthier diet, according to recommendations announced today.

The Food Standards Agency (FSA) has called on manufacturers to reduce saturated fat in biscuits, cakes, buns and chocolate confectionery and sugar in soft drinks.

It also wants consumers to have a greater choice of sizes in chocolate confectionery and soft drinks.



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Tracy was interviewed along with long-term partner



▶ **Justin Bieber caught kissing girl from his Baby video**

Millions of hearts set to break now the teen is romancing Jasmine Villegas



▶ **The celebrity couple half the size they were:**



# Danish Fat Tax

- Dairy industry seeks policy rethink on saturated fats
- Draft bill: a levy of 25 DKR/kg of saturated fats is imposed on e.g. saturated fats in butter, cheese and blends
- Will increase the price of butter by 33%, blends by 24% and cheese by 7%
- The intention of the levy is for producers to pass on the bill to consumers

Estimated that over a period of 10 y the levy will prolong the average lifetime of Danes by 5.5 d

**Not all recent data support  
the fact that saturated fat is  
bad**



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ARTICLE

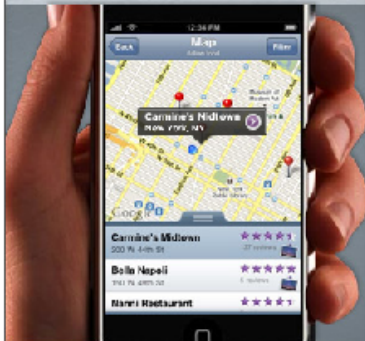
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YAHOO! SEARCH

# Study fails to link saturated fat, heart disease

By Amy Norton  
NEW YORK | Thu Feb 4, 2010 11:19am EST

(Reuters Health) - The saturated fat found mainly in meat and dairy products has a bad reputation, but a new analysis of published studies finds no clear link between people's intake of saturated fat and their risk of developing heart disease.

Research has shown that saturated fat can raise blood levels of "bad" LDL cholesterol, and elevated LDL is a risk factor for heart disease and stroke. Because of this, experts generally advise people to limit their intake of fatty meat, butter and full-fat dairy.

The American Heart Association (AHA) suggests that adults get no more than 7 percent of their daily calories from the fat; for someone who eats 2,000 calories a day, that translates into fewer than 16 grams of saturated fat per day.

But in the new analysis, which combined the results of 21 previous studies, researchers found no clear evidence that higher saturated fat intakes led to higher risks of heart disease or stroke.

The findings, published in the American Journal of Clinical Nutrition, may

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Diet changes improve older adults' cholesterol too

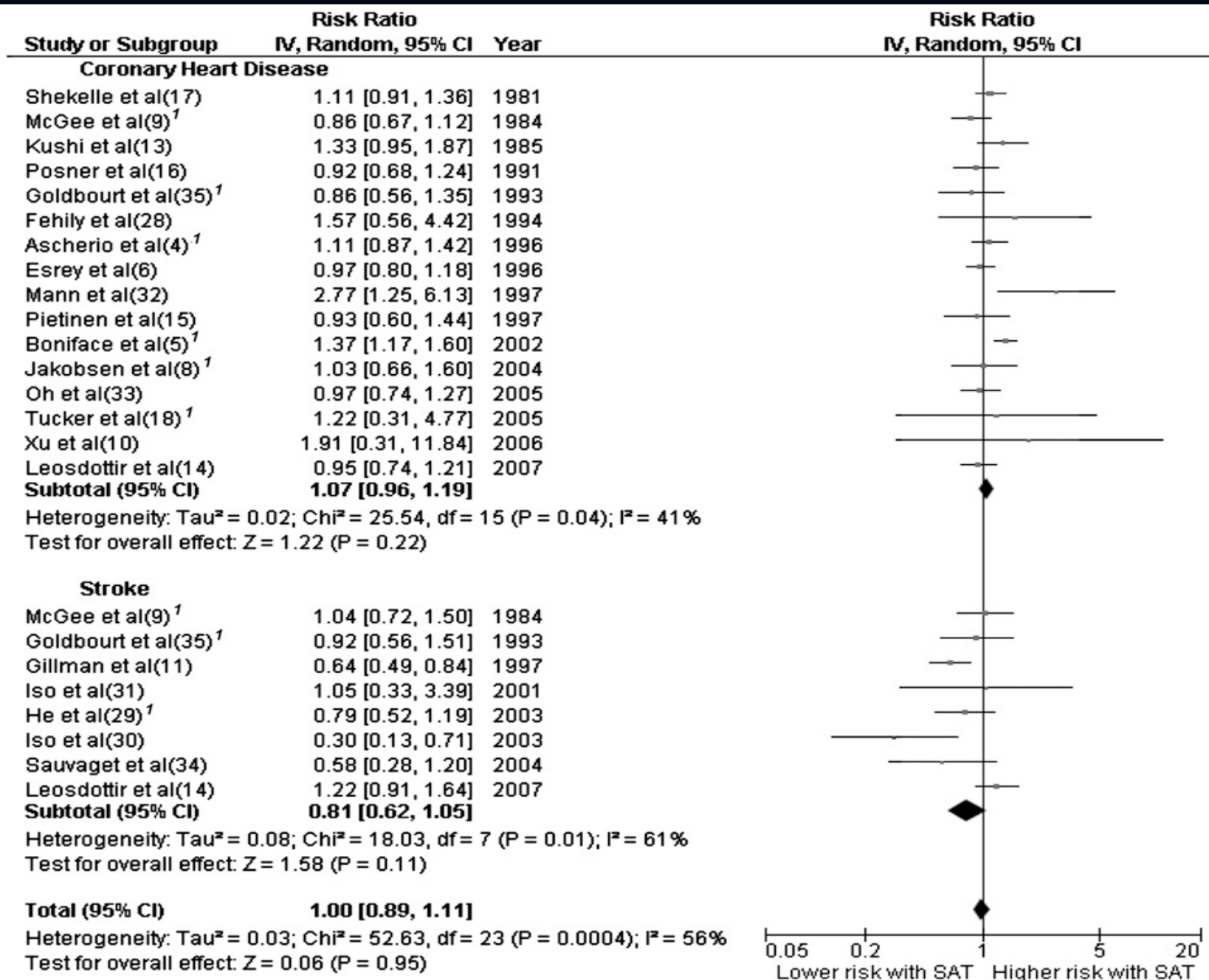
Fri, Jan 29 2010

Mediterranean diet good for the heart

Wed, Jan 27 2010

Low-carb diet best for lowering blood



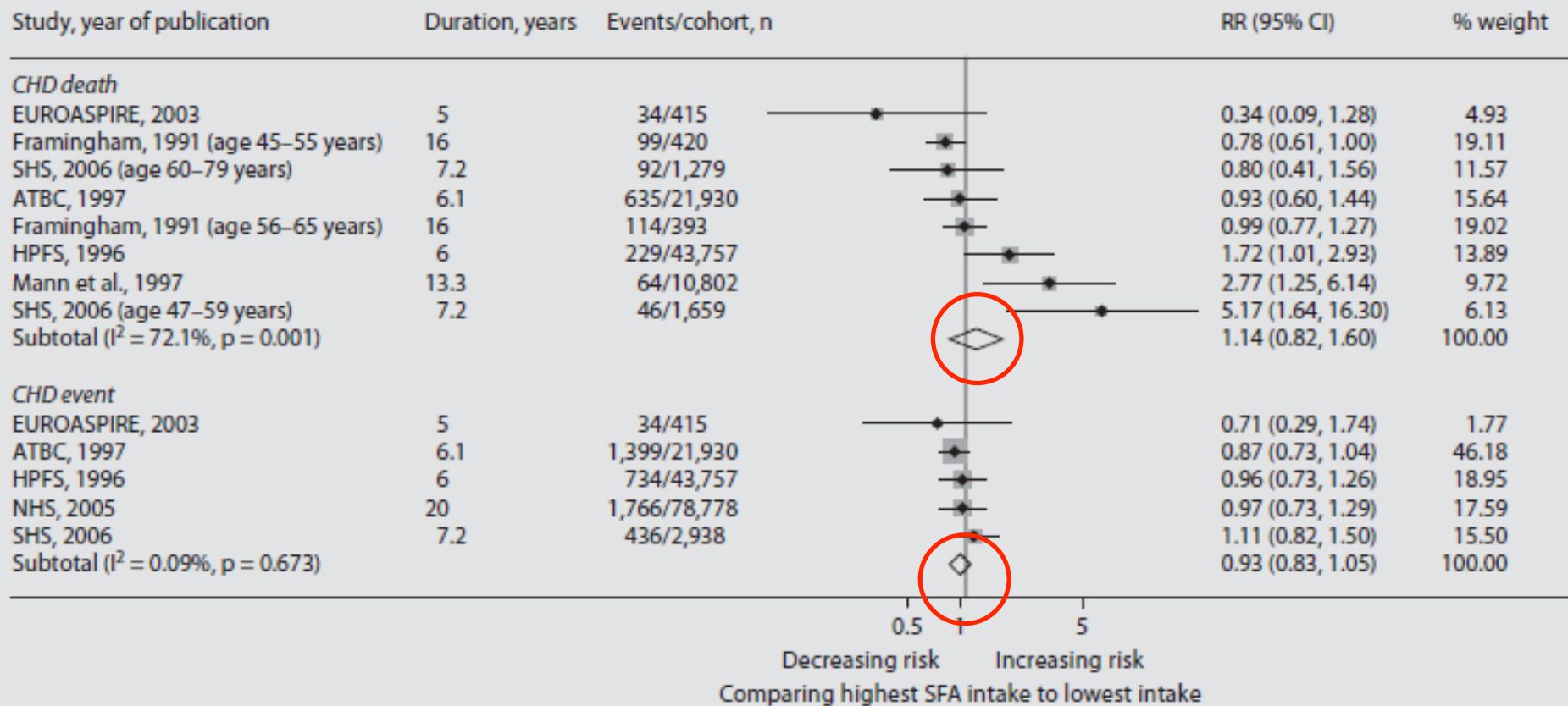


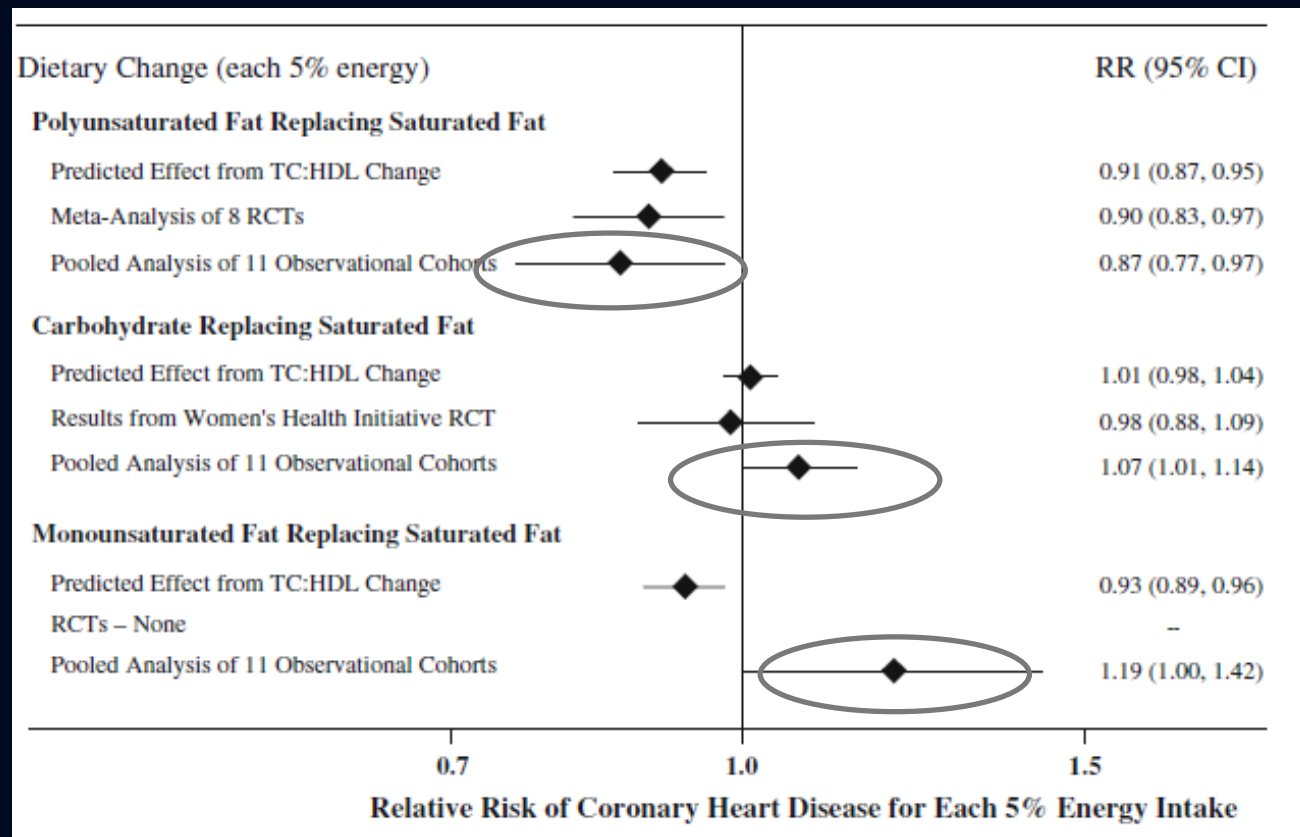
Dietary intake of saturated fatty acids and mortality from cardiovascular disease in Japanese: the Japan Collaborative Cohort Study for Evaluation of Cancer Risk Study<sup>1-3</sup>

*Kazumasa Yamagishi, Hiroyasu Iso, Hiroshi Yatsuya, Naohito Tanabe, Chigusa Date, Shogo Kikuchi, Akio Yamamoto, Yutaka Inaba, and Akiko Tamakoshi for the JACC Study Group*

**SFA intake was inversely associated with mortality from total stroke, including intraparenchymal haemorrhage and ischemic stroke subtypes, in this Japanese cohort**

# No effect of SFA on CHD based on a meta-analysis of prospective cohorts





or, more importantly, disease endpoints. Based on consistent evidence from human studies, replacing SFA with polyunsaturated fat modestly lowers coronary heart disease risk, with ~10% risk reduction for a 5% energy substitution; whereas replacing SFA with carbohydrate has no benefit and replacing SFA with monounsaturated fat has uncertain effects. Evidence for the effects of SFA

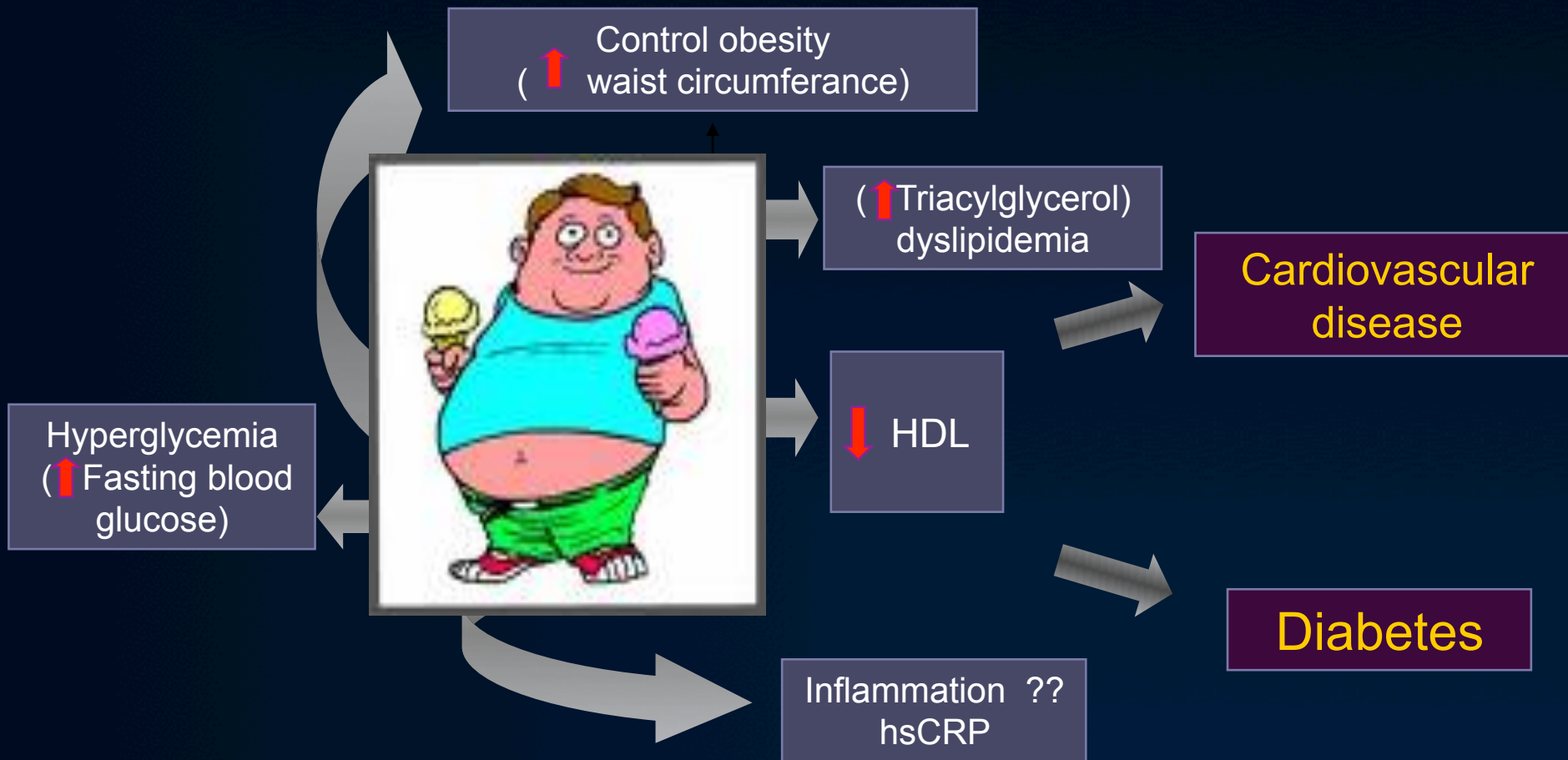


# Total fat and CHD: Modern Evidence

**Joint FAO/WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition, November 10-14, 2008, WHO HQ, Geneva**

**“The consultation examined the background papers, scientific reports and various studies assessing the relationship between total dietary fats as well as selected fatty acids and various physiological conditions and illnesses.**

**The experts agreed that there is no probable or convincing evidence for significant effects of total dietary fats on CHD and cancers.”**



# Metabolic Syndrome

Lipids (2010) 45:385–392  
DOI 10.1007/s11745-010-3416-1

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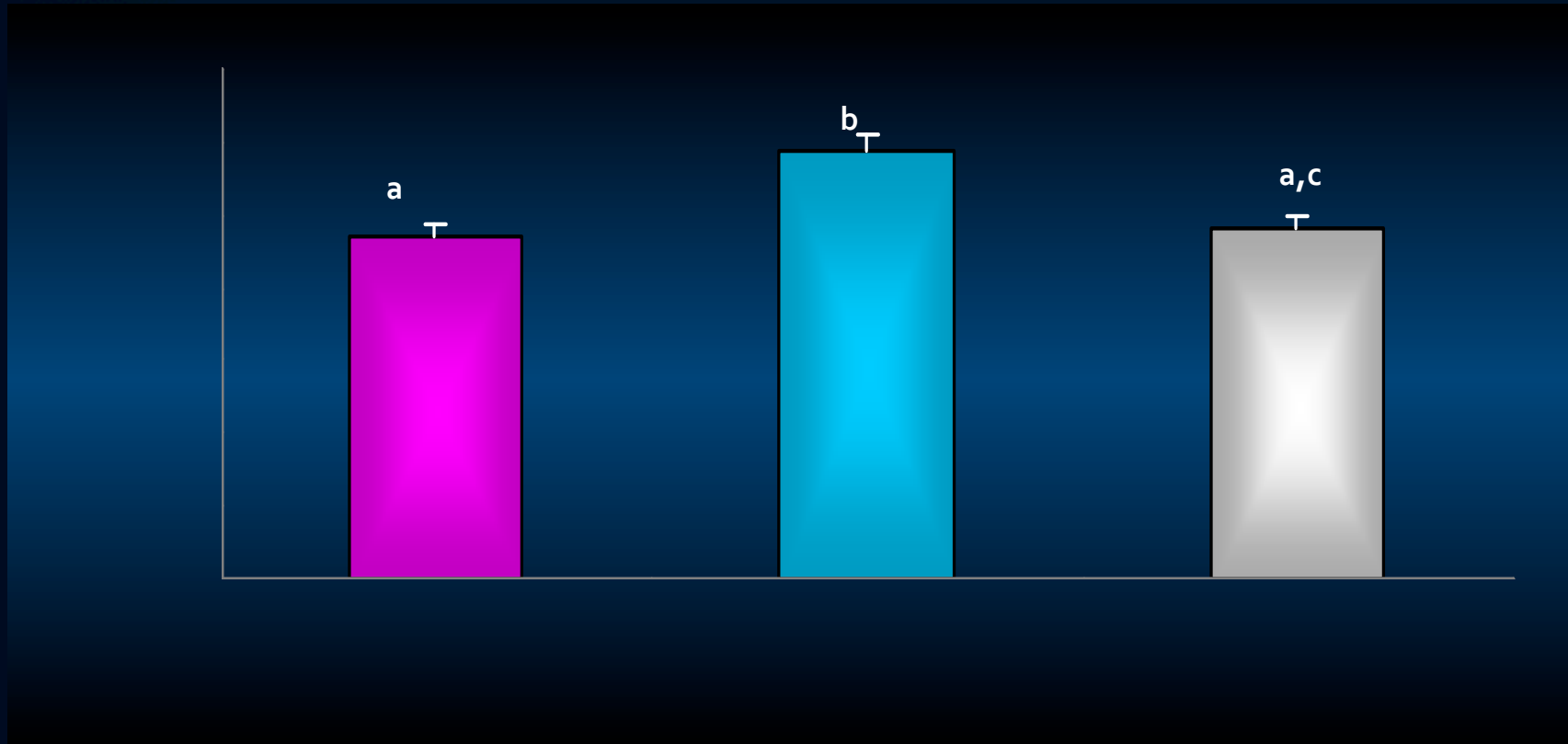
ORIGINAL ARTICLE

## **Effects of Partially Hydrogenated, Semi-Saturated, and High Oleate Vegetable Oils on Inflammatory Markers and Lipids**

**Kim-Tiu Teng · Phooi-Tee Voon · Hwee-Ming Cheng ·  
Kalanithi Nesaretnam**

Received: 19 January 2010 / Accepted: 12 April 2010 / Published online: 1 May 2010  
© AOCS 2010

## HOPO & PST ↓ hsCRP levels compared to PHSO



Mean  $\pm$  SEM. *a,b,c*  $P < 0.05$ .

# MPOB Focus Research

- **CHD Risk**

*Sn2*

- **Phytonutrients**

*Tocotrienols*

*Phenolics*

*Squalene*

*Co-enzyme Q<sub>10</sub>*

*Carotenoids*

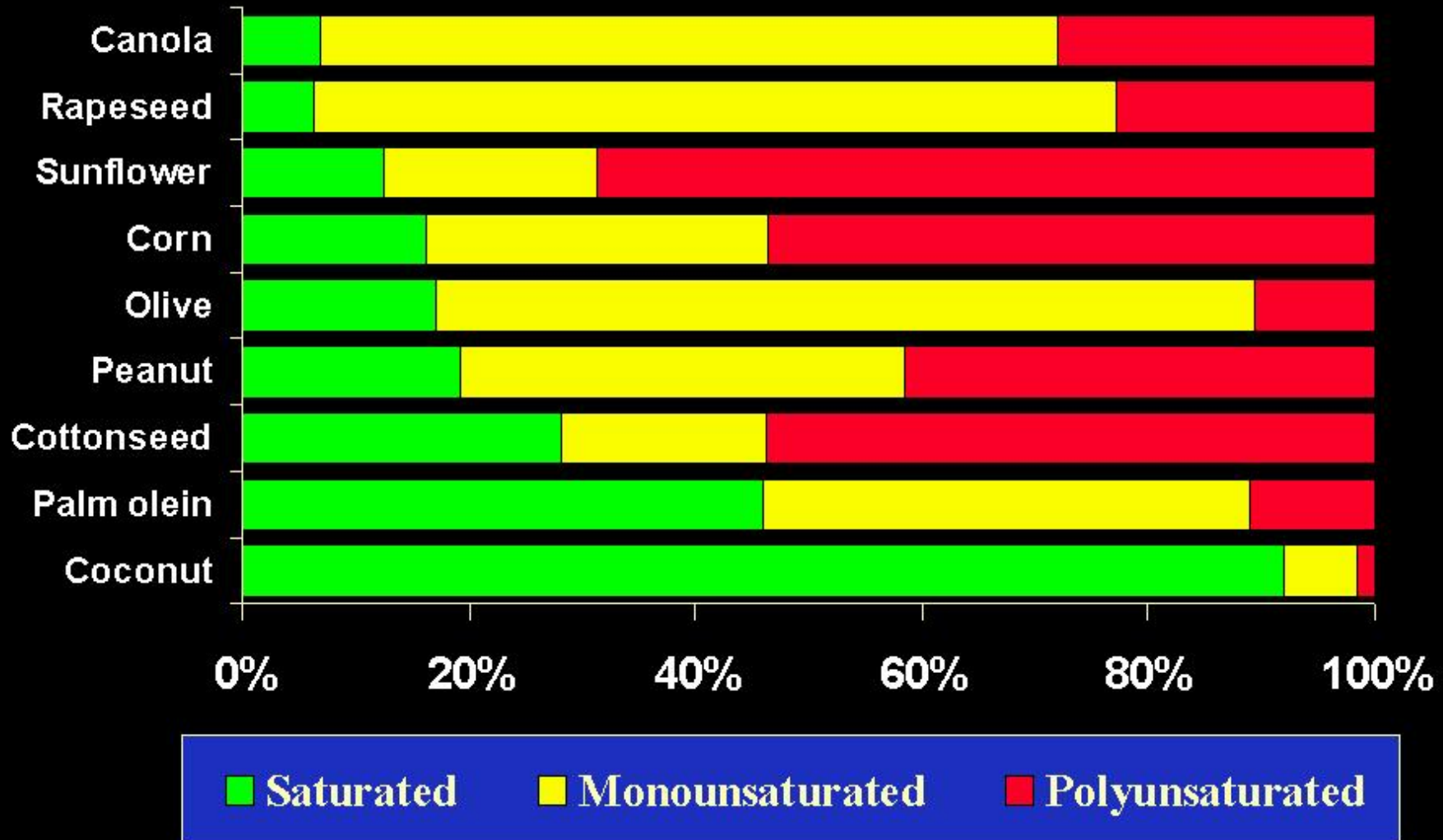
- **Red Palm Oil**

**Why Sn - 2 ?**

# Classification of Oils And Fats

- **SATURATED**
  - PALM KERNEL OIL , COCONUT OIL
- **MONOUNSATURATED**
  - OLIVE OIL , CANOLA OIL
- **POLYUNSATURATED**
  - SOYABEAN OIL , CORN OIL

# Fatty Acid Composition of Common Vegetable Oils

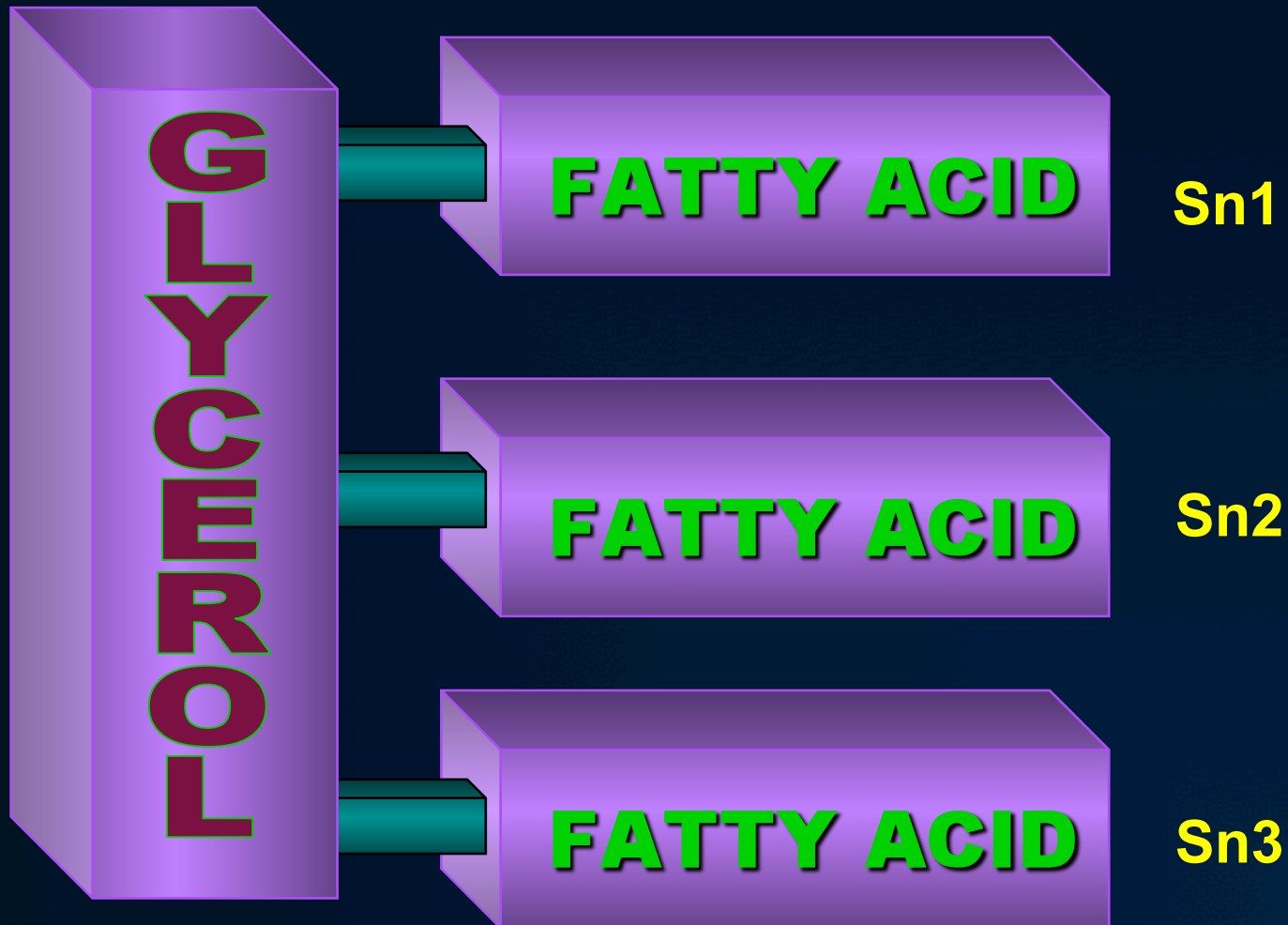




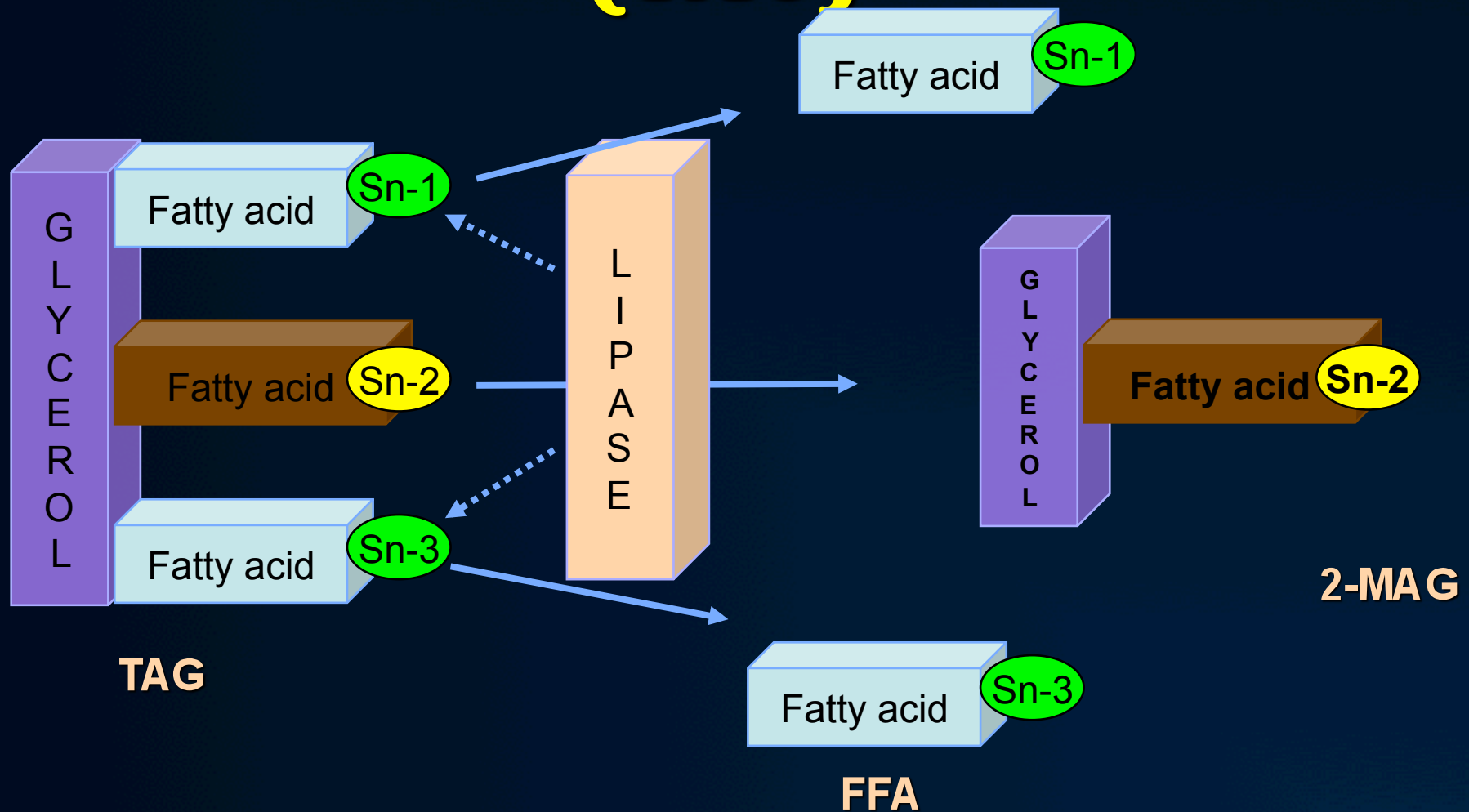
# Sn-2 Hypothesis

Fatty acid composition alone does not tell you the whole story -the position of the fatty acid in the TG is more important.

# A Triglyceride - Structure



# Triacylglycerides Structure (TAG)



Saturated fatty acids are better absorbed in the form of 2-MAG than as FFA

# Stereospecificity of Native Triglycerides

- In Vegetable Oils-the sn2 position is primarily oleic acid (C18:1) & linoleic acid (C18:2) which are unsaturated fatty acids
- whilst in Animal Fats the sn-2 position is saturated

# Virgin Olive Oil



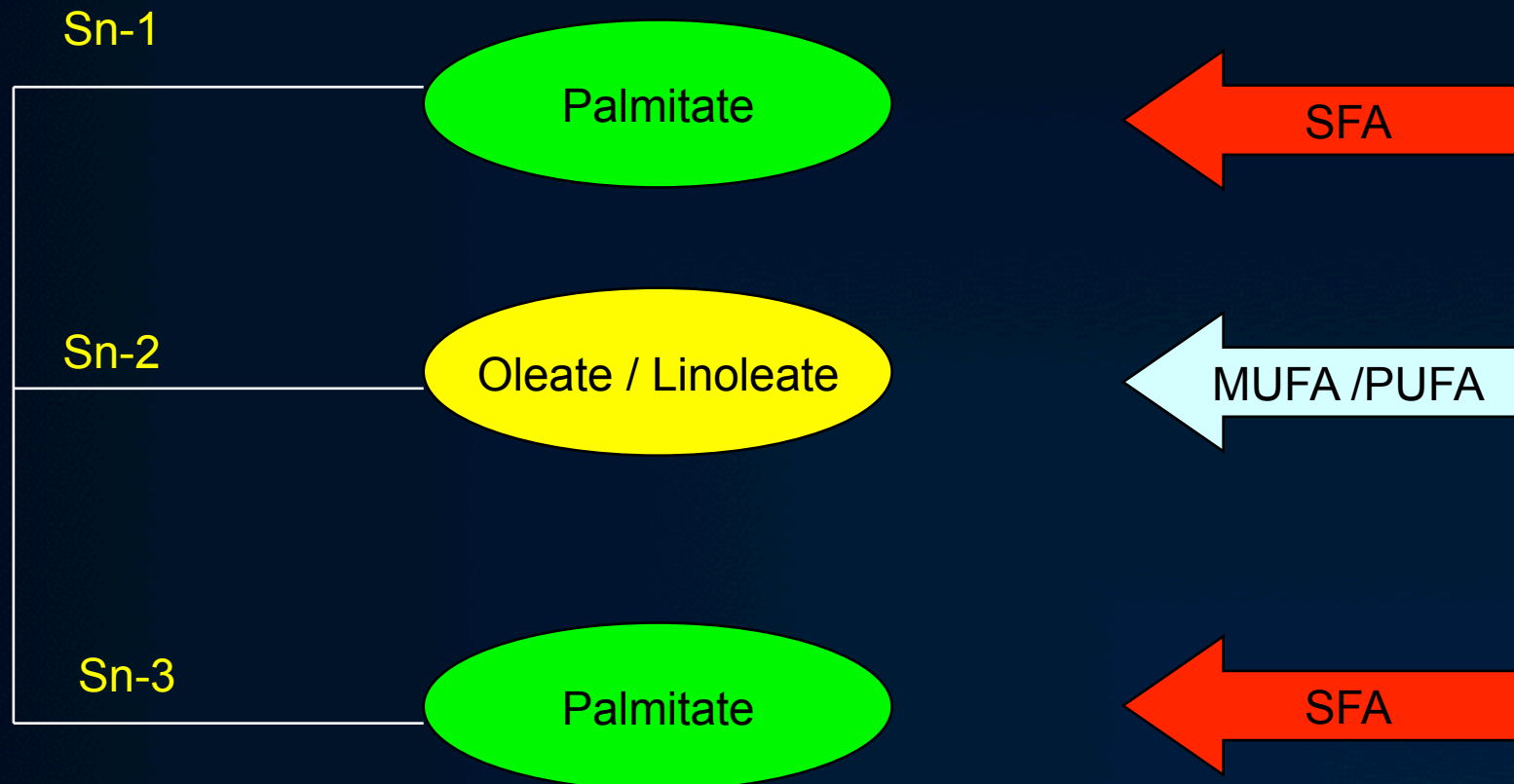
**GLYCEROL**

**Oleic Acid**

**Oleic Acid**

**Linoleic Acid**

# TAG in Palm Oil





Saturated fatty acids are better absorbed in the form of 2-MAG than as free fatty acids

**GLYCEROL**

**Palmitic acid**

**Sn2**





**BETAPOL®**

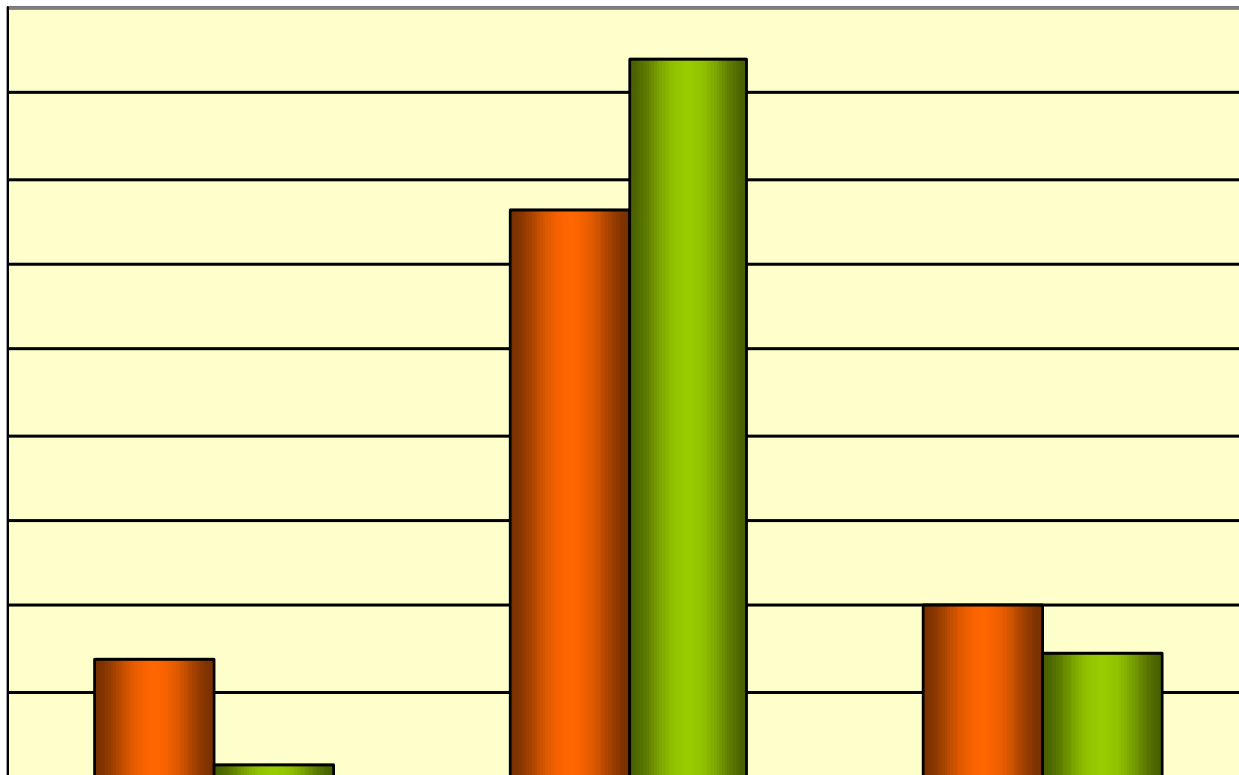
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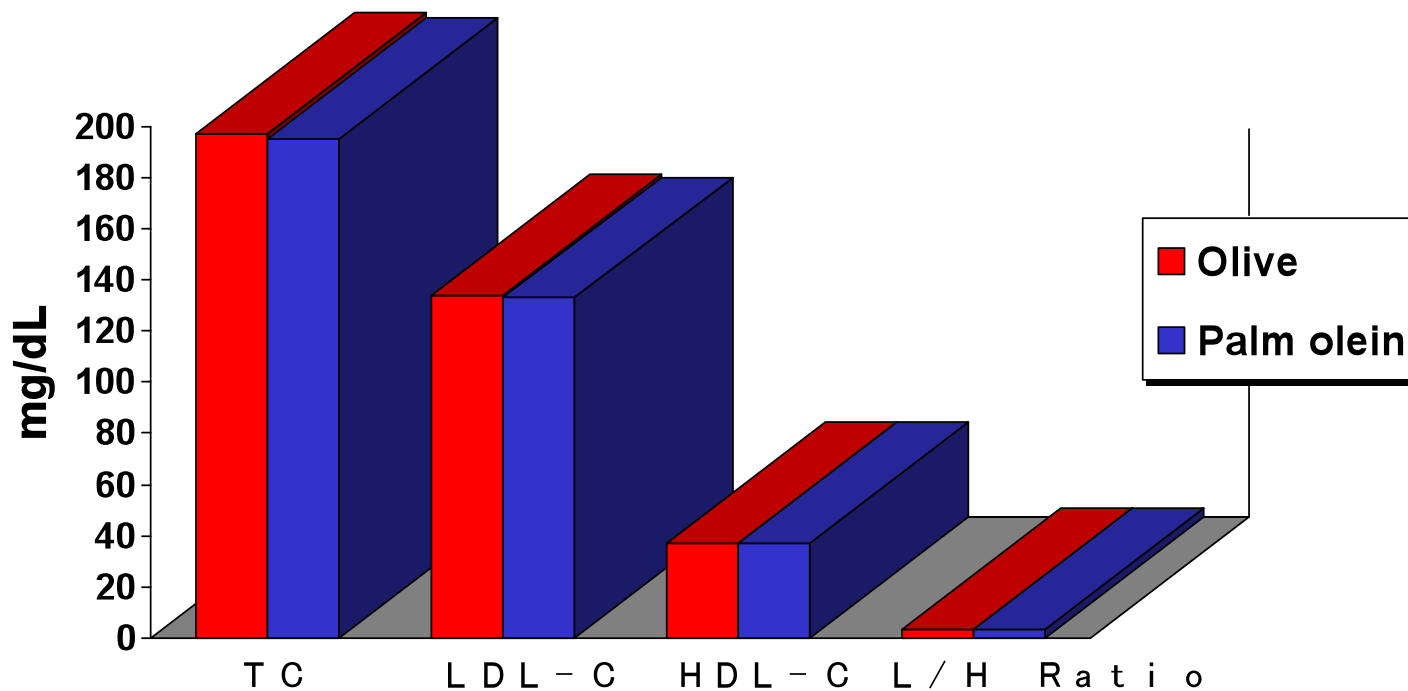
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# Comparison of the fatty acids in the *sn*-2 position between Palm Olein and Olive Oil



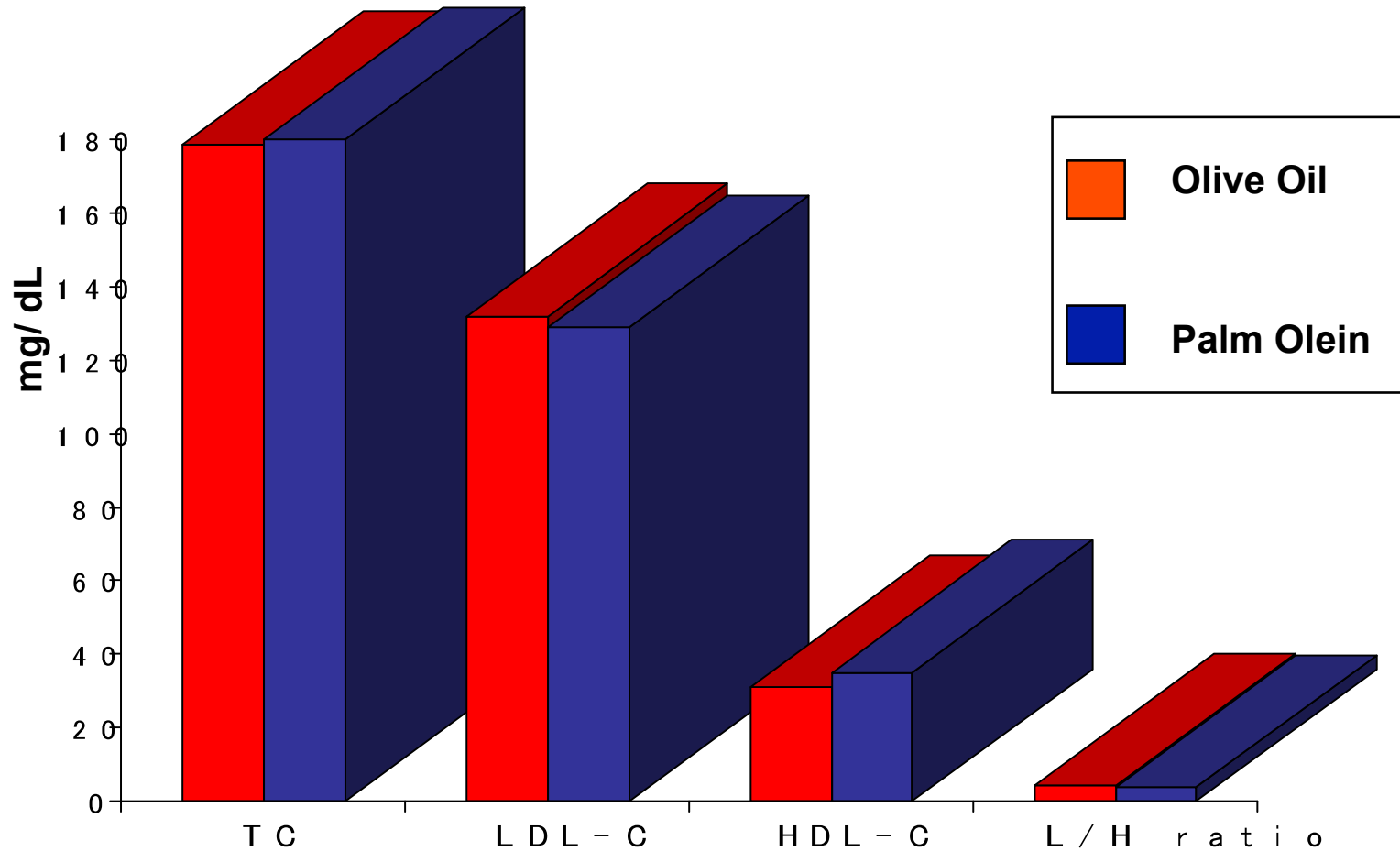
## Olive Oil and Palm Olein Have Similar Effects on Plasma Cholesterol in Humans



Human subjects fed diets predominating as either olive oil or palm olein showed identical plasma cholesterol response.

# Olive Oil and Palm

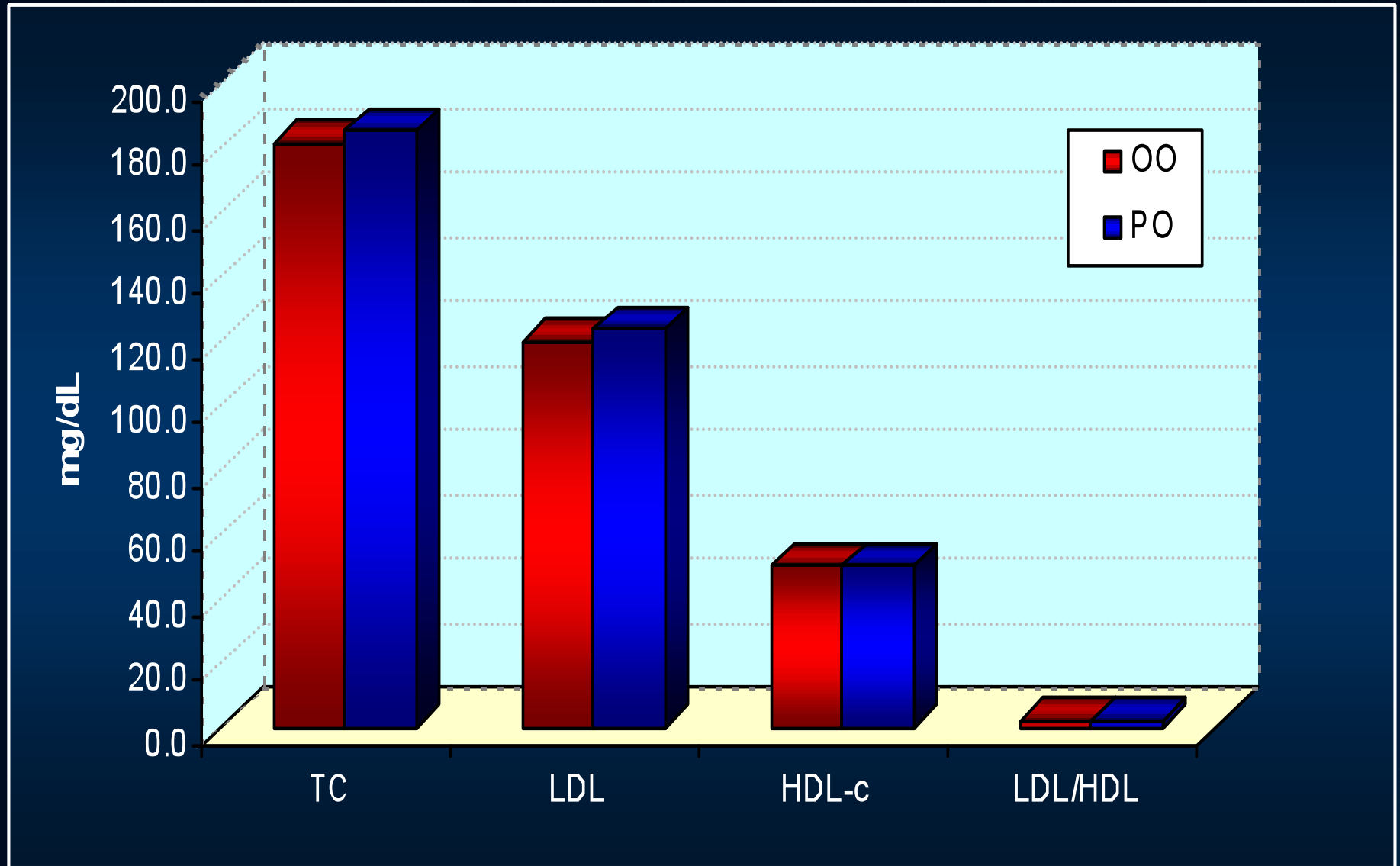
Palm Olein and Olive Oil have similar effect on Plasma Cholesterol in Humans



**Human subjects fed diets predominating as either olive oil or palm olein showed identical plasma cholesterol response.**

*Choudhury et al. (1995), Am. J. Clin. Nutr.*

# Palm Olein vs Olive Oil



*Voon et al. 2010 (MPOB)*

## Sn2 Study

- King's College London and Maastricht University (Tom Sanders and Ronald Mensink)
- Changing the TAG structure of palm oil by interesterification, to produce a fat with a high proportion of palmitic acid in the *sn*-2 position, will alter postprandial lipid and glucose metabolism.

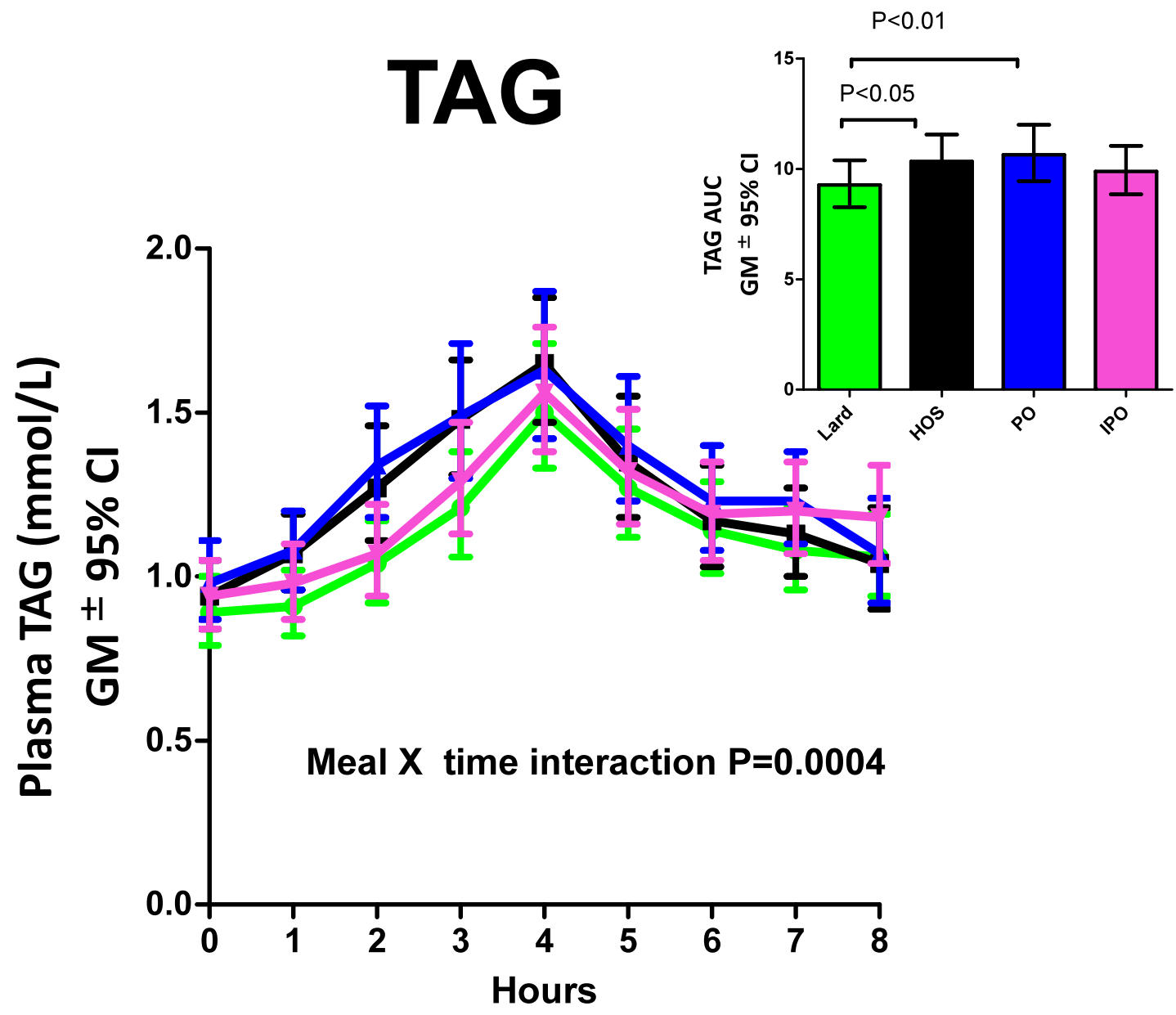


# Muffin and milkshake test meal

Test fats	TAG fatty acid composition (wt %)			<i>sn</i> -2 palmitic acid (%)
	SFA	MUFA	PUFA	
High oleic sunflower oil (control)	7	81	11	0
Lard	44	43	10	55
Interesterified palm olein	45	42	12	41
Native palm olein	45	42	12	13

Test meal macronutrient composition			
Energy (kcal)	Carbohydrate (g)	Fat (g)	Protein (g)
905	91	50	15

# TAG



# **Healthy Innovative Oils**

# **MPOB's new innovative healthy oil products**

- **High oleic oils**
- **Lower saturated palm olein**
- **High diglyceride palm oil products**

## COMMERCIALISATION OF NOVELIN

- A new innovative oil for temperate countries.
- Passed cold stability, even with 1:1:1 (sat: mono: poly) fatty acid ratios.
- New formulation of 0.4:1:0.4 ratio for low saturates formula
- Transfer of technology to ACE Edible Oil Industries Sdn Bhd.
- Health benefits shown in clinical trial and animal studies.



# Antioxidants





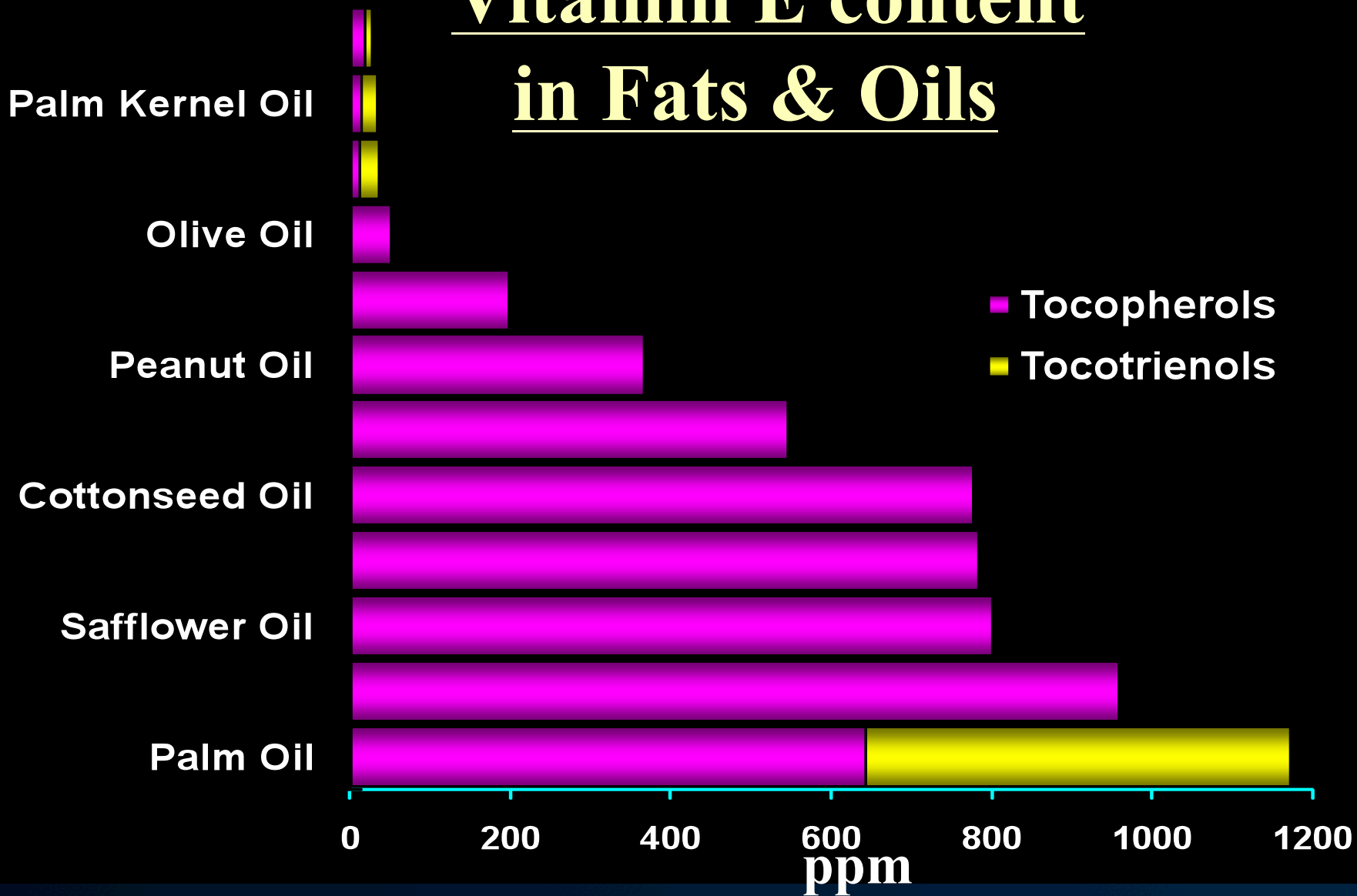
# Major Phytonutrients in Palm Oil

Phytonutrients	Concentration (ppm)
Tocols (Tocotrienols, Tocopherols)	600-1000
Carotenoids ( $\alpha$ -carotene, $\beta$ -carotene, lycopene, phytoene)	500-700
Phytosterols (Sitosterol, Stigmasterol, Campesterol)	300-620
Squalene	250-540
Lecithin (Phospholipids)	20-100
Co-enzyme Q10 / Ubiquinones	10-80
Polyphenols (Phenolic acids, Flavonoids)	40-70

Choo *et al.* 2008.



# Vitamin E content in Fats & Oils












*Refs: H.T. Slover, Lipids 6:291 (1971); F.D. Gunstone (1986)*

# Commercial Product





# RESEARCH ON TOCOTRIENOLS TO DATE

-  T3 and Breast and Prostate Cancer
-  T3 and Neuroprotection
-  T3 and Pre-eclampsia
-  T3 and Immune Response
-  T3 and Anti-inflammation
-  T3 and Atherosclerosis
-  T3 and Cholesterol Lowering
-  T3 and Ophthalmology-Cataracts
-  T3 and Platelet Aggregation

# TOCOTRIENOLS

## Anti-cancer effects

- Human prostate cancer cells (Srivastava & Gupta 2006, Nesaretnam *et al.* 2008)
- Breast cancer cells (Nesaretnam *et al.* 1995, 1998, 2004, Yu *et al.* 2005)
- Anti-angiogenesis (Miyazawa *et al.* 2008, Weng-Yew *et al.* 2009)

## Neuroprotection

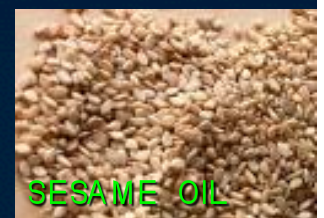
$\alpha$ -tocotrienols at nanomolar concentration provide neuroprotection (Sen *et al.* 2000)

Independent of anti-oxidant property

Tocotrienols inhibit c-Src activity in glutamate-induced neurodegeneration (Khanna *et al.* 2002)

## Cardiovascular Protection

- Inhibition of cholesterol synthesis (Qureshi *et al.* 1991, Parker *et al.* 1993, Song *et al.* 2006)
- Reversing Artherosclerosis (Tomeo *et al.* 1995)





## Breast Cancer Research



This Provisional PDF corresponds to the article as it appeared upon acceptance. Copyedited and fully formatted PDF and full text (HTML) versions will be made available soon.

### Effectiveness of tocotrienol-rich fraction combined with tamoxifen in the management of women with early breast cancer: a pilot clinical trial

*Breast Cancer Research* 2010, 12:R81 doi:10.1186/bcr2726

Kalanithi Nesaretnam (sarnesar@mpob.gov.my)

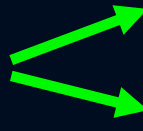
Kanga Rani Selvaduray (krani@mpob.gov.my)

Ghazali Abdul Razak (zaliraz@mpob.gov.my)

Sheela Devi Veerasenan (sheeladevi@mpob.gov.my)

Patricia A Gomez (pgomez@pantai.com.my)

# Clinical Trial

- 240  *120 Tamoxifen+ placebo*  
*120 Tamoxifen + Tocotrienol*
- Primary Breast Cancer ER+
- Stage 1 & 2
- Lymph nodes



**Table 2: Tocotrienol intake and risk of breast cancer specific death/ recurrence in women with early breast cancer and estrogen receptor positive tumors receiving tamoxifen**

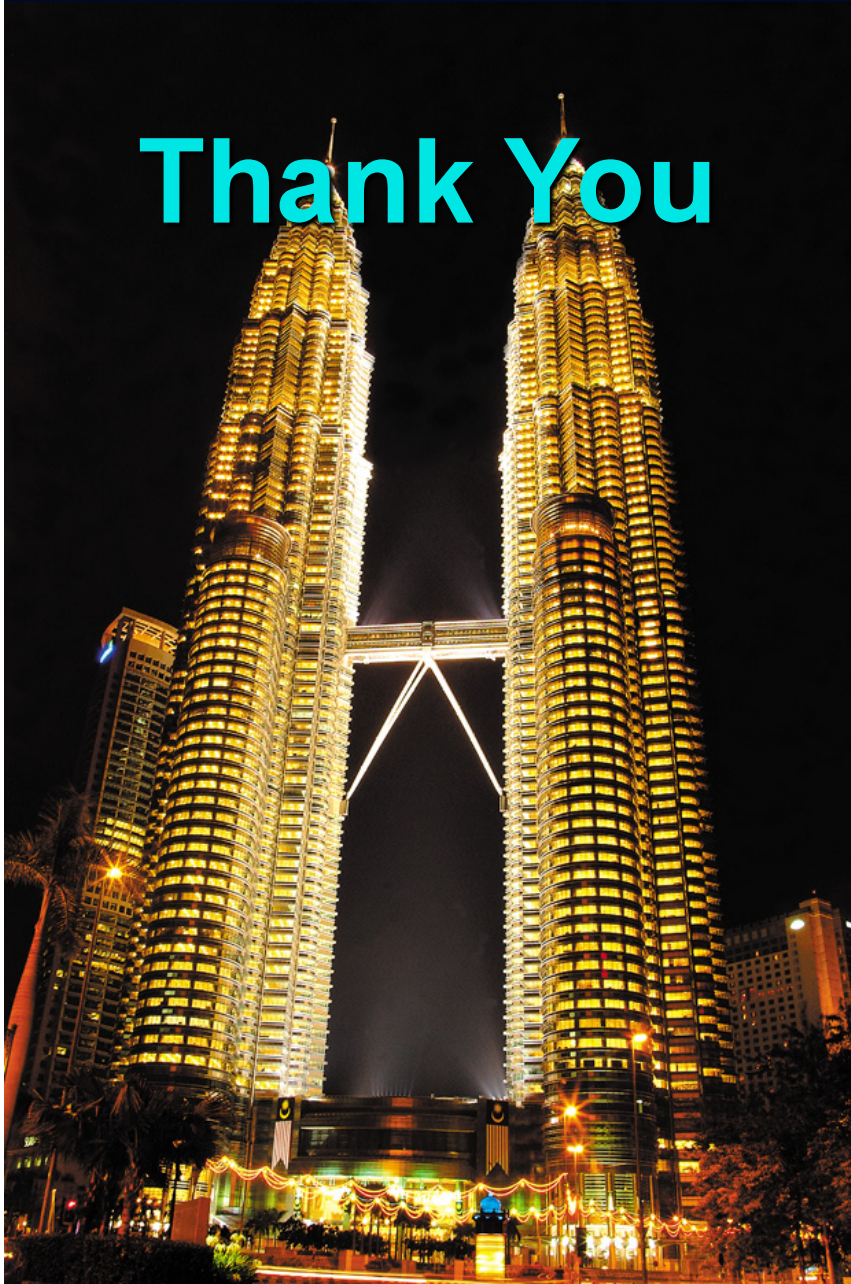
Outcome	Received Tocotrienol		Relative Risk (95% CI)	Absolute risk reduction (95% CI)	Numbers needed to treat
	Yes n=120 % (Number)	No n=120 % (Number)			
<b>Primary endpoint</b> Breast Cancer Related Death	0.017 (2)	0.050 (6)	0.33	-0.03	30
			(0.07 to 1.62)	(-0.09 to 0.02)	
<b>Secondary endpoint</b> Recurrence	0.133 (16)	0.167 (20)	0.80	-0.03	30
			(0.44 to 1.47)	(-0.13 to 0.06)	

# Summary

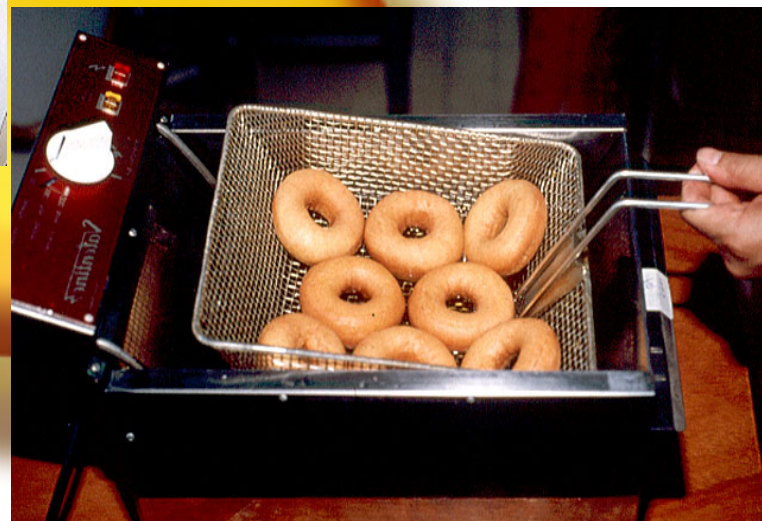
- Palm oil is a nutritious oil with a balanced FAC
- Has essential fatty acid (C18:2)
- Rich in Phytonutrients-Antioxidants
- No *trans* fatty acids
- Not genetically modified
- Good oxidative stability
- Good functional properties
- Consistent supply

**Thank You**

**See You At  
MPOB International  
Palm Oil Congress  
November 2011  
Kuala Lumpur  
Convention Centre  
Malaysia**



# Palm Olein an Excellent Oil for Frying







# Less Development Of Undesirable Materials

*Polar components*

*French Legislation Stipulate 27% Max. for Used Frying Oil*

