Palm Oil Nutrition Research : What's New

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Head of Nutrition Unit
Malaysian Palm Oil Board

Presentation Outline

- Introduction
- Current Views on Saturated Fats
- *Latest findings on Palm Oil Nutrition*
- Take home messages

PALM OIL IN GLOBAL OILS AND FATS, 2021

Production
241.36 Mn T

PO	SBO	RSO	SFO	Others*
32%	25%	11%	8%	24%

Export
95.18 Mn T

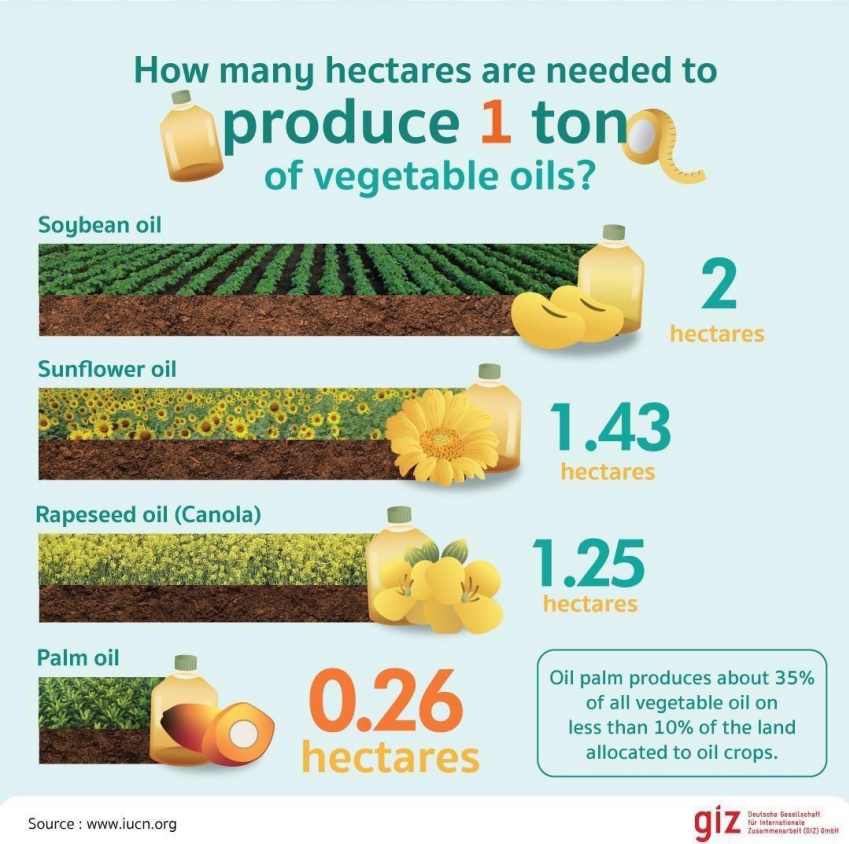
PO	SBO	SFO	RSO	Others*
54%	14%	12%	7%	13%

*Cotton oil, Groundnut oil, Sesame oil, Corn oil, Coconut oil, Butter (as fat), Lard, Tallow & Grease, Linseed oil, Castor oil.

2nd Largest Producer and Exporter of Palm Oil

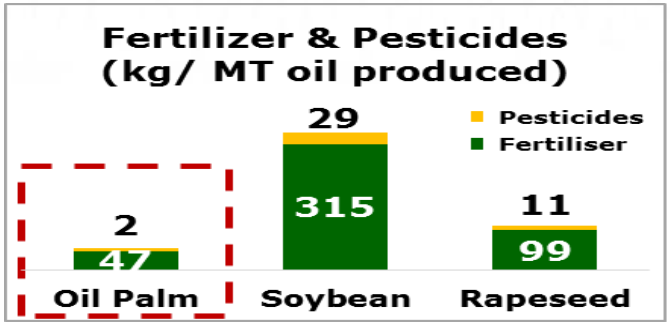
Sources: Oil World; MPOB

Oil Palm – The Most Productive Oil Crop



Oil Palm – The Most Productive Oil Crop

- 6 to 8 MT/Ha of oil yields can be achieved by more efficient Oil Palm producers
- Oil Palm requires the least fertilisers and pesticides among oilseed crops



Source: MPOC, The New Straits Times, MPOB, Oil World 16/17, Palm Oil Action Group Australia, The Guardian (2014)

Oil Palm – The Most Productive Oil Crop

Oil Crops	Production (Mn T)	% of total production	Total area (Mn Ha)	% of total area
Oil palm*	78.26	44.17	19.07	**9.28**
Soybean	54.92	31.00	125.68	61.24
Rapeseed	25.55	14.42	33.36	16.24
Sunflower	18.43	10.40	27.351	13.31

The Oil Palm at a Glance

Oil Palm Tree
(***Elaeis guineensis***)

Fresh Fruit Bunch (**FFB**)

Oil Palm Fruits

from **Mesocarp**

Palm Oil

from **Kernel**

Palm Kernel Oil

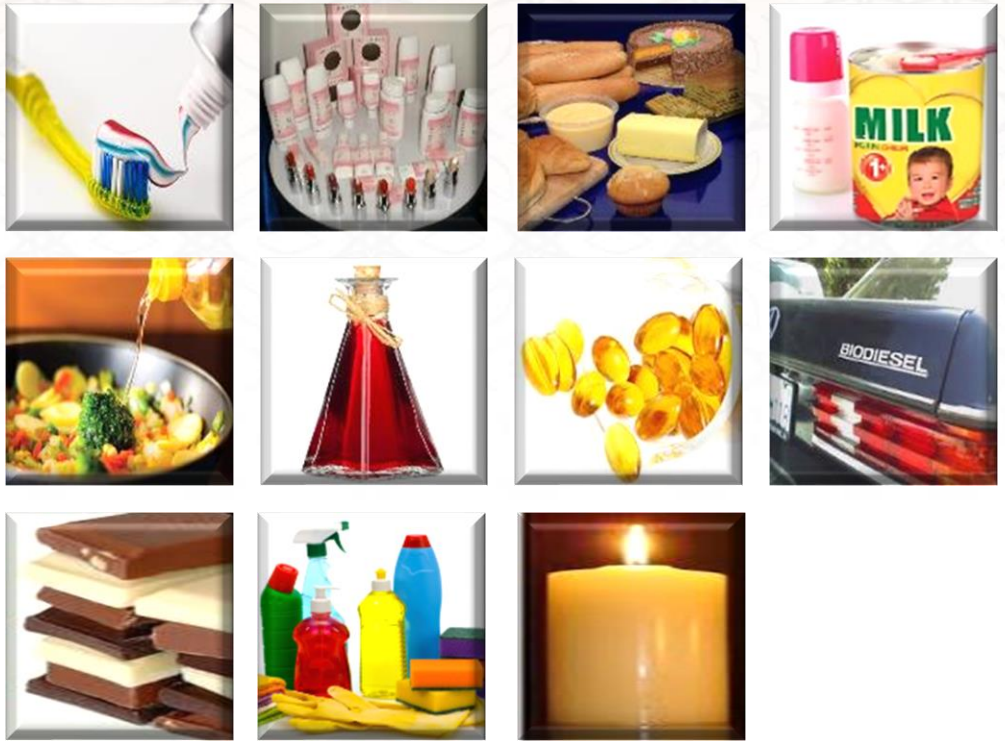
Oil palm tree produces two types of oil

Oil Palm Fruit Oils & Fats

✓ At least 12 types of palm-based oils and fats of different physicochemical properties can be produced from oil palm fruits

Oils and Fats from Mesocarp	Oils and Fats from Kernel
1. Palm oil (semi solid) 2. Palm olein (liquid) 3. Super olein (liquid) 4. Top olein (liquid) 5. Palm stearin (solid) 6. Soft stearin (solid) 7. Superhard stearin (solid) 8. Soft palm mid fraction (solid) 9. Hard palm mid fraction (solid)	1. Palm kernel oil (semi solid) 2. Palm kernel olein (semi solid) 3. Palm kernel stearin (solid)

PALM OIL: PART OF OUR LIFE



Palm oil is with us all day – from the moment we wake up until we go to bed.

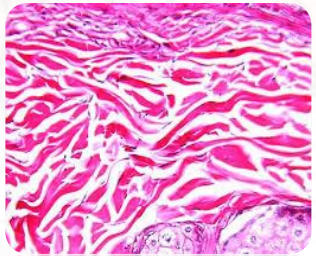
- Palm oil is found in almost **50% of food products** in the supermarket; from chocolates to biscuits and peanut butter to ice-cream.
- Palm oil in its various fractions and derivatives are a common ingredient in these food products.
- **Oleochemicals** derived from palm are also used in the production of **personal care products, detergents and household cleaning products.**

Functional Roles of Oils and Fats

- Enhances palatability and satiety of foods
- Acts as a cooking medium
- Assists in determining the consistency, texture, mouthfeel

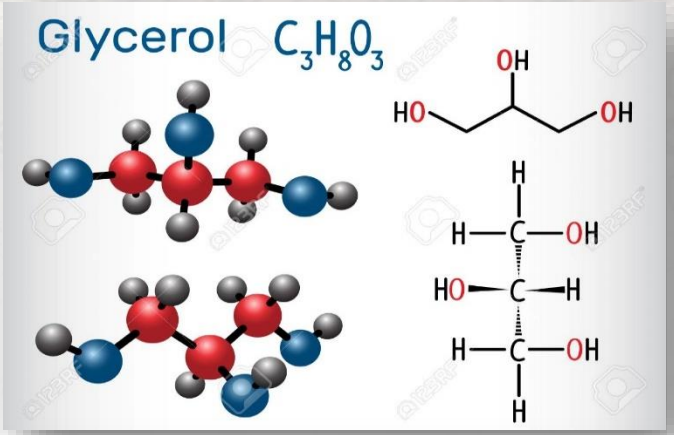
Physiological Roles of Oils and Fats

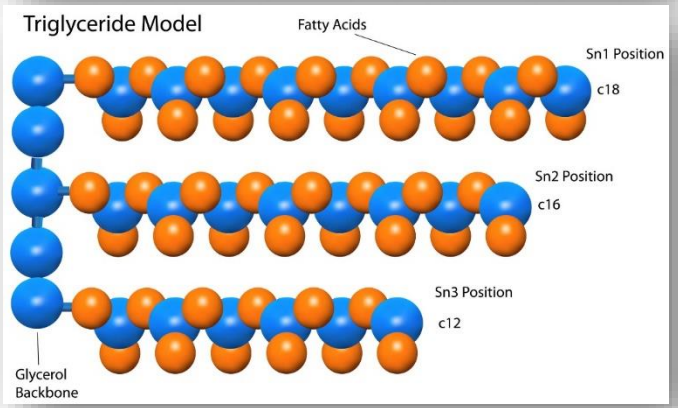
- Macronutrient concentrated source of energy
- Source of essential fatty acids (EFA)
- Carrier for the A,D,E,K vitamins
- Essential for healthy skin and tissues
- Functioning of nerve cells and brain
- Functioning of steroid hormones (regulate body processes)



Fats and Oils

- Mainly made up of triglycerides
- **Fatty acids esterified to a glycerol backbone**
- Fatty acids differ in structure (chain length and bonding)





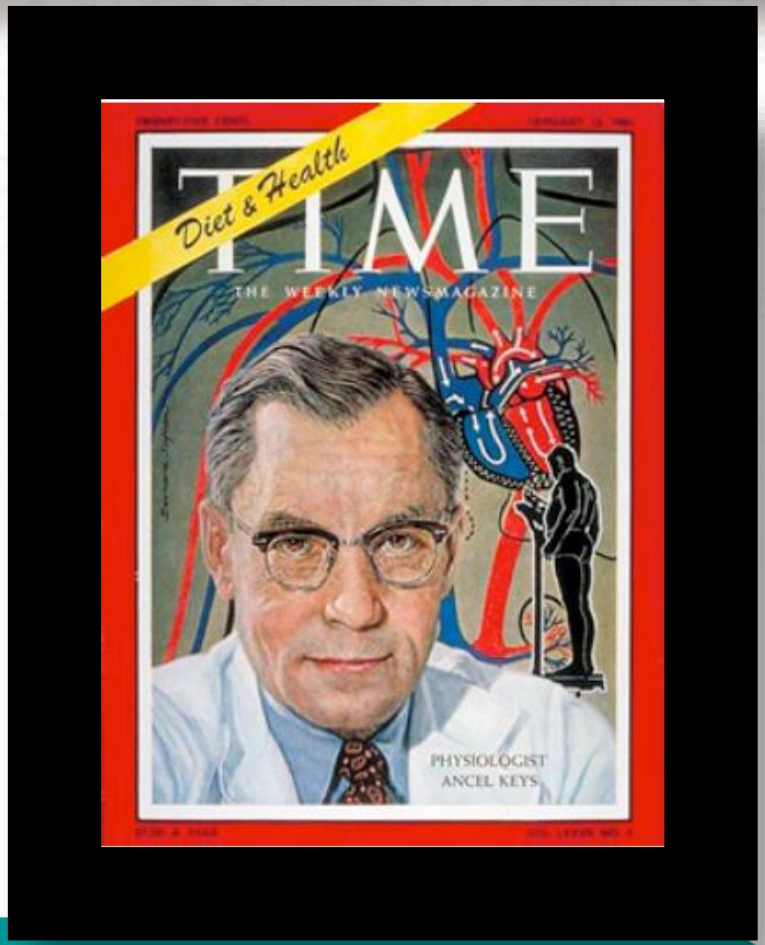
Conventional Views on Saturated Fats

Current Recommendation for Saturated Fats

- **Limit energy intake from total fats and shift fats consumption *away from saturated fats to unsaturated fats***
- **The total intake of SFA not exceed 10% en.**
- **SFA should be replaced with PUFA (n-3 and n-6) in the diet**

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

The Diet-Heart Theory



In the late 1950s, Ancel Keys postulated that fats cause heart disease and saturated fats raise cholesterol levels

Often referred to as the lipids theory or diet-heart theory, it became widely accepted.

However, current evidence shows otherwise

CURRENT OPINION ON SATURATED FATS

Saturated Fat and Heart Diseases

2005 Report of European Cardiovascular Disease Statistics 2005

2009 Skeaf

2010 Siri-Tar

2011 Astrup

2011 Mozaffaria

2014 Chowdhury et al.

2015 Laura

2015 Souza et al.

hghan et al.
RE - Lancet)

ombe et al.

2018 Gershuni et al.

2019 DuBroff and de Longeril

No association between saturated fat intake and CVD

Astrup et al. (J Am Coll Cardiol)

THE PRESENT AND FUTURE

JACC STATE-OF-THE-ART REVIEW

Saturated Fats and Health: A Reassessment and Proposal for Food-Based Recommendations

JACC State-of-the-Art Review

Arne Astrup, MD, DMSc,[a] Faidon Magkos, PhD,[a] Dennis M. Bier, MD,[b] J. Thomas Brenna, PhD,[c,d,e] Marcia C. de Oliveira Otto, PhD,[f] James O. Hill, PhD,[g] Janet C. King, PhD,[h] Andrew Mente, PhD,[i] Jose M. Ordovas, PhD,[j] Jeff S. Volek, PhD, RD,[k] Salim Yusuf, DPhil,[l] Ronald M. Krauss, MD[l,m]

ABSTRACT

The recommendation to limit dietary saturated fatty acid (SFA) intake has persisted despite mounting evidence to the contrary. Most recent meta-analyses of randomized trials and observational studies found no beneficial effects of reducing SFA intake on cardiovascular disease (CVD) and total mortality, and instead found protective effects against stroke. Although SFAs increase low-density lipoprotein (LDL) cholesterol, in most individuals, this is not due to increasing levels of small, dense LDL particles, but rather larger LDL particles, which are much less strongly related to CVD risk. It is apparent that the health effects of foods cannot be predicted by their content in any nutrient group without ring the overall macronutrient distribution. Whole-fat dairy, unprocessed meat, and dark chocolate are SFA-rich a complex matrix that are not associated with increased risk of CVD. The totality of available evidence rt further limiting the intake of such foods. (J Am Coll Cardiol 2020;76:844-57) © 2020 The Authors. ier on behalf of the American College of Cardiology Foundation. This is an open access article under nse (http://creativecommons.org/licenses/by-nc-nd/4.0/).

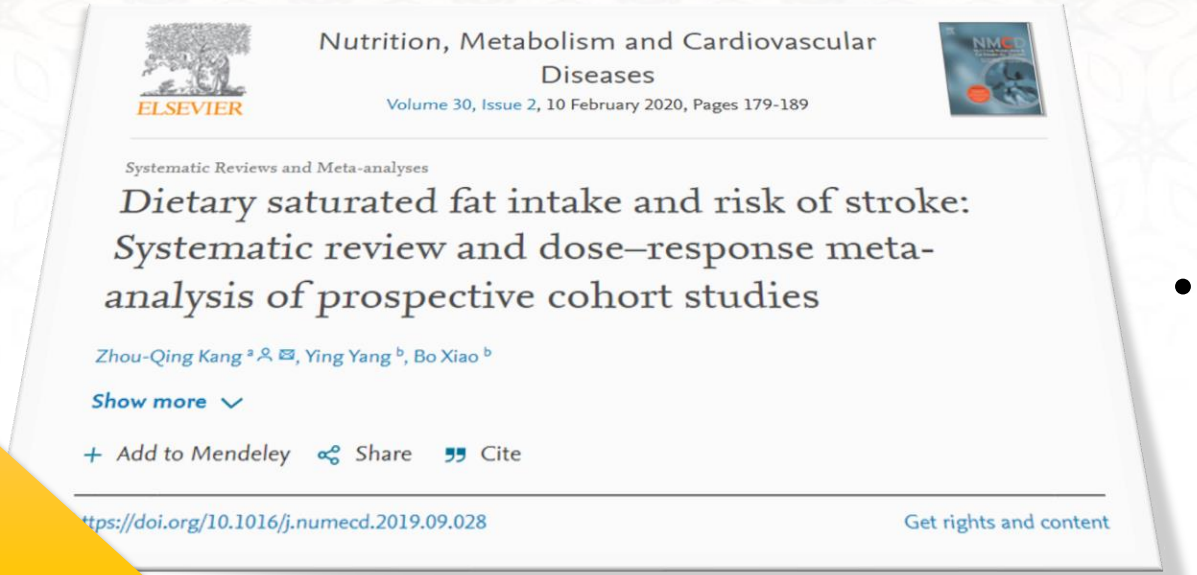
2020

Most recent meta-analyses of RCT and observational studies found

- no beneficial effects of reducing SFA intake on CVD and total mortality, and instead found protective effects against stroke.

Although SFAs increase LDL cholesterol, in most individuals, this is not due to increasing levels of small, dense LDL particles, but rather larger LDL particles, which are much less strongly related to CVD risk.

Kang et al.



ELSEVIER

Nutrition, Metabolism and Cardiovascular Diseases

Volume 30, Issue 2, 10 February 2020, Pages 179-189

Systematic Reviews and Meta-analyses

Dietary saturated fat intake and risk of stroke: Systematic review and dose–response meta-analysis of prospective cohort studies

Zhou-Qing Kang [a], Ying Yang [b], Bo Xiao [b]

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https://doi.org/10.1016/j.numecd.2019.09.028 Get rights and content

- A **higher** consumption of dietary **SFA** is associated with a **lower risk of stroke**.
- Every **10 grams/day increase** in **SFA** intake is associated with a **6%** relative risk **reduction** in the rate of **stroke**.

2020

Diamond et al.

Low carbohydrate diet rich in saturated fat increased LDL size, thereby lowers CVD risk

2020

Review > Curr Opin Endocrinol Diabetes Obes. 2020 Oct;27(5):291-300.
doi: 10.1097/MED.0000000000000568.

Low carbohydrate diet: are concerns with saturated fat, lipids, and cardiovascular disease risk justified?

David M Diamond [1], Blair J O'Neill [2], Jeff S Volek [3]

Affiliations + expand

PMID: 32773573 DOI: 10.1097/MED.0000000000000568

Abstract

Purpose of review: There is an extensive literature on the efficacy of the low carbohydrate diet (LCD) for weight loss, and in the improvement of markers of the insulin-resistant phenotype, including a reduction in inflammation, atherogenic dyslipidemia, hypertension, and hyperglycemia. However, critics have expressed concerns that the LCD promotes unrestricted consumption of saturated fat, which may increase low-density lipoprotein (LDL-C) levels. In theory, the diet-induced increase in LDL-C increases the risk of cardiovascular disease (CVD). The present review provides an assessment of concerns with the LCD, which have focused almost entirely on LDL-C, a poor marker of CVD risk. We discuss how critics of the LCD have ignored the literature demonstrating that the LCD improves the most reliable CVD risk factors.

Recent findings: Multiple longitudinal clinical trials in recent years have extended the duration of observations on the safety and effectiveness of the LCD to 2-3 years, and in one study on epileptics, for 10 years.

Summary: The present review integrates a historical perspective on the LCD with a critical assessment of the persistent concerns that consumption of saturated fat, in the context of an LCD, will increase risk for CVD.

Laguzzi et al. (Scientific Reports)

Observation from multicenter longitudinal study (7 centers across 5 European countries) ;

"**No clear associations** were observed between **high intake of saturated fat** and risk of **atherosclerotic progression**."

2021

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Article | Open Access | Published: 12 April 2021

Intake of food rich in saturated fat in relation to subclinical atherosclerosis and potential modulating effects from single genetic variants

Federica Laguzzi ✉, Buamina Maitusong, Rona J. Strawbridge, Damiano Baldassarre, Fabrizio Veglia, Steve E. Humphries, Rainer Rauramaa, Sudhir Kurl, Andries J. Smit, Philippe Giral, Angela Silveira, Elena Tremoli, Anders Hamsten, Ulf de Faire, Bruna Gigante, Karin Leander & IMPROVE Study group

Scientific Reports **11**, Article number: 7866 (2021) | Cite this article

3643 Accesses | **45** Altmetric | Metrics

Abstract

The relationship between intake of saturated fats and subclinical atherosclerosis, as well as the possible influence of genetic variants, is poorly understood and investigated. We aimed to investigate this relationship, with a hypothesis that it would be positive, and to explore whether genetics may modulate it, using data from a European cohort including 3,407 participants aged 54–79 at high risk of cardiovascular disease. Subclinical atherosclerosis was

Astrup et al. (Nutrients)

nutrients

MDPI

Article

Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based?

Arne Astrup [1,*], Nina Teicholz [2], Faidon Magkos [3], Dennis M. Bier [4], J. Thomas Brenna [5,6,7], Janet C. King [8], Andrew Mente [9,10], José M. Ordovas [11,12], Jeff S. Volek [13], Salim Yusuf [9,14] and Ronald M. Krauss [15,16]

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check for updates

Citation: Astrup, A.; Teicholz, N.; Magkos, F.; Bier, D.M.; Brenna, J.T.; King, J.C.; Mente, A.; Ordovas, J.M.; Volek, J.S.; Yusuf, S.; et al. Dietary Saturated Fats and Health: Are the U.S. Guidelines Evidence-Based? *Nutrients* **2021**, *13*, 3305. https://doi.org/10.3390/nu13103305

...demic Editors: Susanna Iossa ...anna L. Gibson

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...neutral ...s in

Abstract: The last decade has seen nearly 20 papers reviewing the totality of the data on saturated fats and cardiovascular outcomes, which, altogether, have demonstrated a lack of rigorous evidence to support continued recommendations either to limit the consumption of saturated fatty acids or to replace them with polyunsaturated fatty acids. These papers were unfortunately not considered by the process leading to the most recent U.S. Dietary Guidelines for Americans, the country's national nutrition policy, which recently reconfirmed its recommendation to limit saturated fats to 10% or less of total energy intake, based on insufficient and inconsistent evidence. Continuation of a cap on saturated fat intake also fails to consider the important effects of the food matrix and the overall dietary pattern in which saturated fatty acids are consumed.

2021

The last decade - ~20 papers reviewing the totality of the data on SFAs and CVD outcomes, - demonstrated a lack of rigorous evidence

- to support continued recommendations either to limit the consumption of SFAS
- or to replace them with PUFAs.

These papers were unfortunately not considered by the process leading to the most recent U.S. Dietary Guidelines for Americans, which recently reconfirmed its recommendation to limit SFAs to ≤10% total En intake, based on insufficient and inconsistent evidence.

The Biologic Importance of Saturated Fat

Cell Membranes	Require (50%) saturated fatty acids to be “waterproof” and function properly
Heart	Prefers saturated long-chain 16-carbon palmitic and 18-C stearic acid (over carbohydrates) for energy
Bones	Need saturated fats to assimilate calcium effectively
Liver	They protect it from the adverse effects of alcohol and medications like acetaminophen
Lungs	Lung surfactant, which prevents asthma and other breathing disorders, is composed entirely of 16-C palmitic acid
Hormones	They function as signalling messengers for hormone production
Immune system	Saturated fats play an important role here. • Prime white blood cells to destroy invading bacteria, viruses and fungi, and to fight tumors. • Medium chain 12-C lauric acid and 14-C myristic acid (in butter) kill bacteria and candida in the gut.
Signal Satiety	So you eat less, lose fat and maintain a normal weight
General Health	Eating saturated fats lowers consumption of health-damaging carbohydrate and polyunsaturated vegetable oils

Important Messages

- The association of **SFA with increasing risk of CVD or CHD** as predicted by Ancel Keys is **not conclusive.**

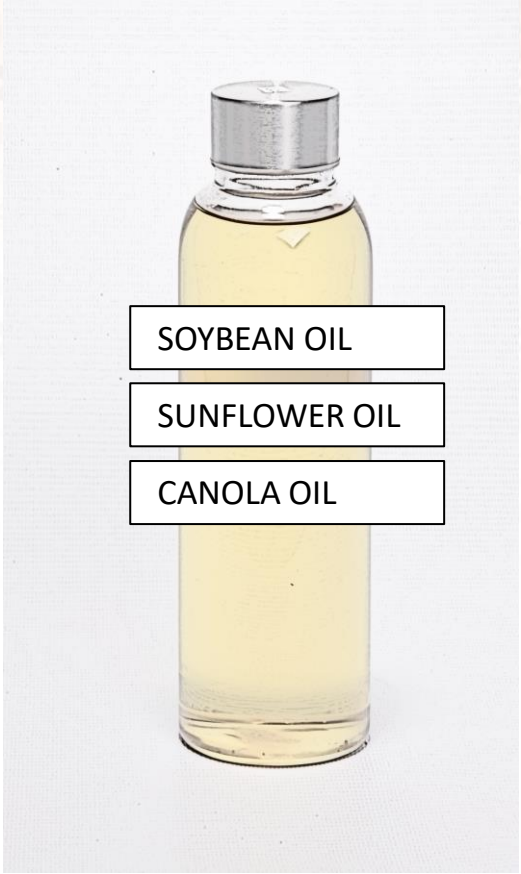
- Understanding – human **digestive and metabolic processes surrounding lipids** - essential to elucidate the effects arising from consuming fats and oils,

- as well as to **debunk further misconceptions on SFA**.

- It's not only fats but it's the **overall diet and lifestyle** that looks after your heart

TRANS FATTY ACIDS

True Culprit



Soybean Oil, Sunflower Oil and Canola oil are liquid at -5°C

HYDROGENATION

Effects of trans fats on health

- raise your bad (LDL) cholesterol levels and lower your good (HDL) cholesterol levels.
- increase your risk of developing heart disease and stroke.
- associated with a higher risk of developing type 2 diabetes.

Palm oil and Palm-based Margarine are Free of Trans Fats

Palm Oil

Hydrogenation

Solid

Benefits of Palm Oil as Replacer for Trans Fats

- Balanced mixture of liquid oils and solid fats
- Natural solid fats
- Free of *trans* fatty acids
- Versatile
- Tailor-made fractions for specified functionality and applications
- Reduction of cost - hydrogenation not required
- Suitable for vegetarians – plant based fat

The New York Times

Trans Fats Should be Eliminated Worldwide by 2023, W.H.O. Says

TRANS FAT
FREE
BY 2023!

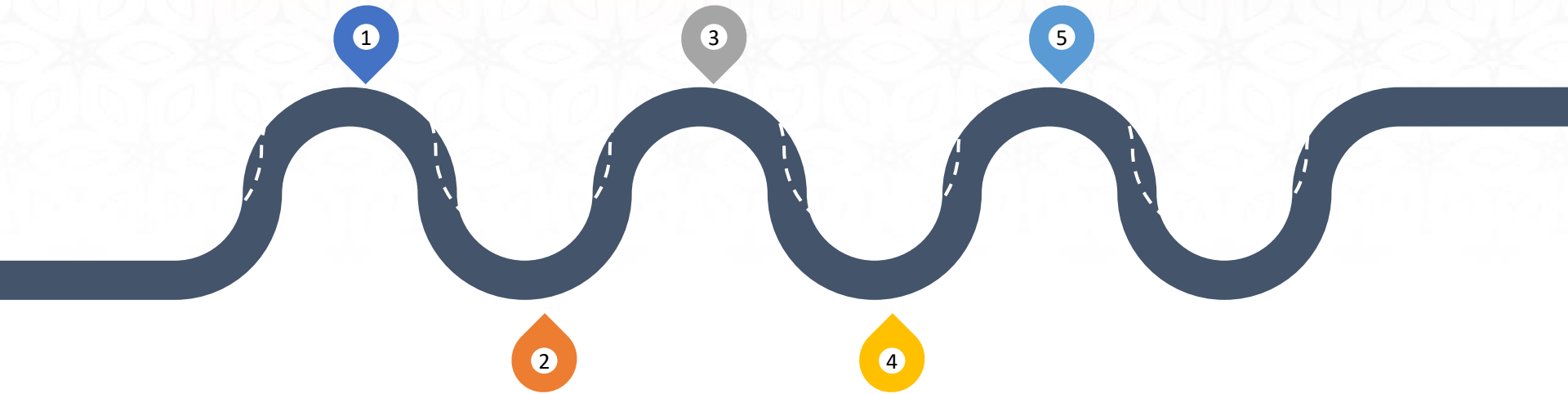
REPLACE
TRANS FAT

World Health Organization

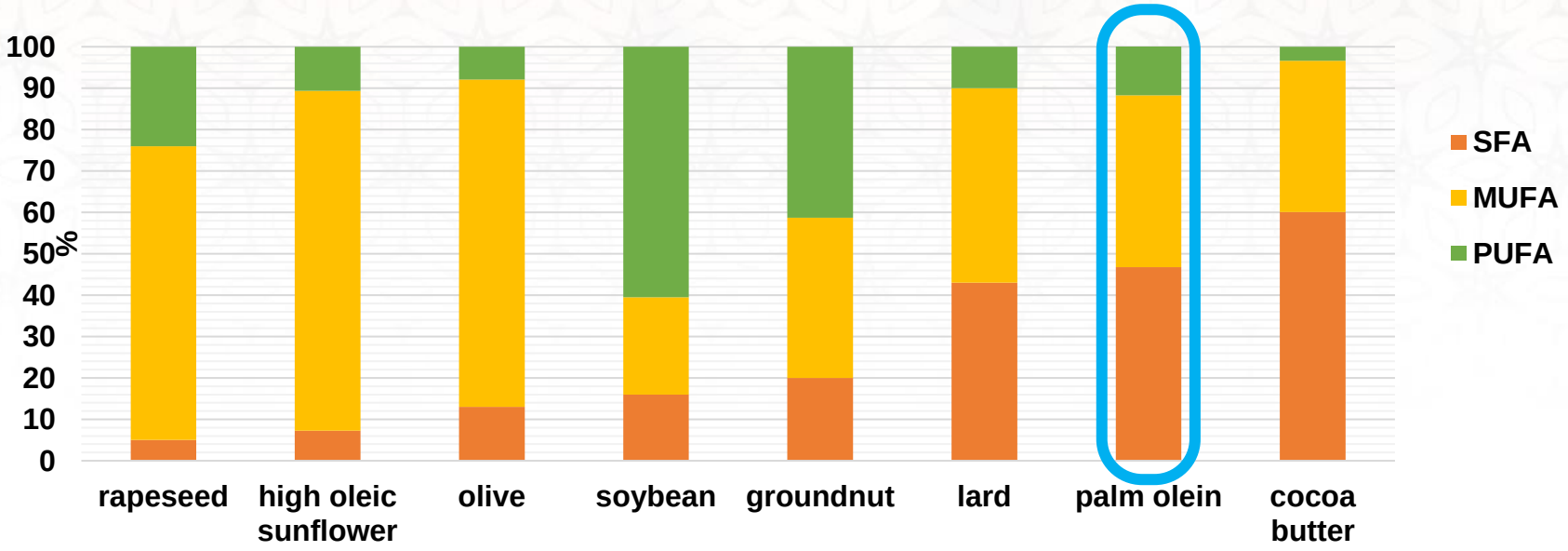
PAALM OIL NUTRITION RESEARCH

- Great strides have been made over the last 35 years in elucidating a number of the health benefits of palm oil and its fractions
- Malaysia has funded numerous nutritional research on palm oil at centers of excellence both locally and abroad
- This has resulted in over 250 publications in high impact peer-reviewed journals

OVERVIEW OF PALM OIL NUTRITION RESEARCH

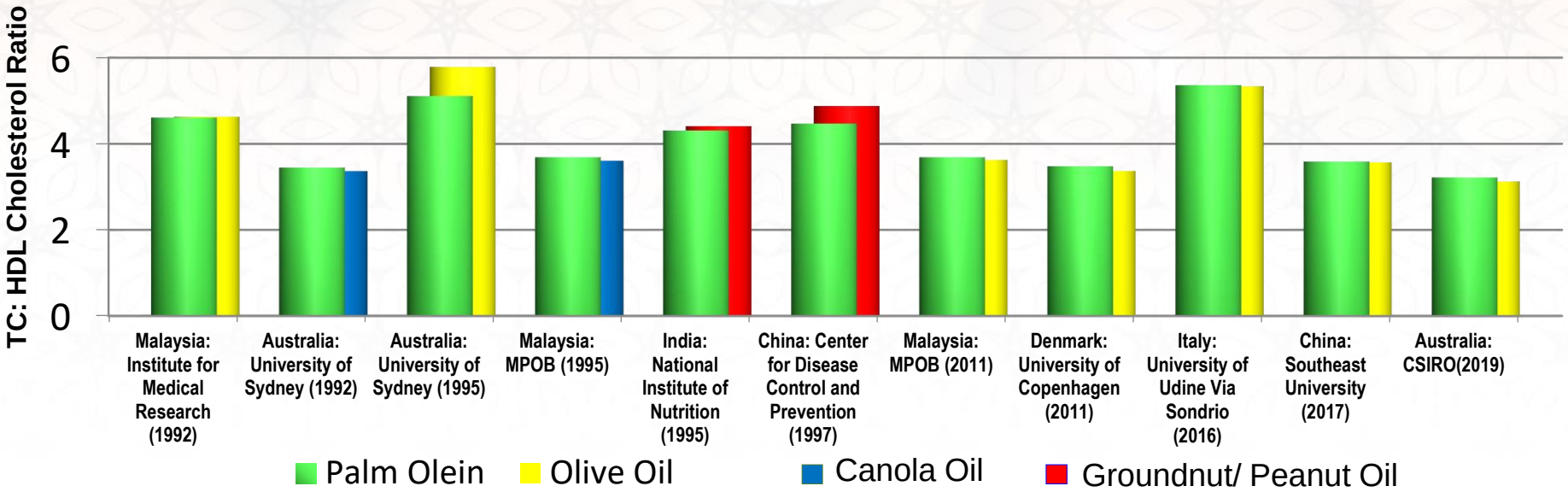


Total fatty acid composition of oils & fats



Source: Ong and Goh 2002 FNB

Human Studies on Long-term Intake of Palm Olein vis-à-vis Other Oils (1992-2019)



Palm olein behaves more like a monounsaturated oil in its effects on cholesterol levels, although it contains saturated fatty acids

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11. *Welma et al., 2019, EJCN*

Palm Olein Has Similar Effects as Unsaturated Oils on Lipid Markers

Palm olein

Sunflower oil

Olive oil

Groundnut oil

Rapeseed oil

- TC
- LDL
- HDL
- TAG
- TC/HDL

META-ANALYSIS - EFFECTS OF PALM OLEIN IN HUMAN LIPID PROFILE

MEDLINE and CENTRAL REGISTER:

- **Randomised Controlled Trials from year 1990 to January 2018**
- **Of at least two weeks' intervention**
- **Comparing the effects of palm olein with other edible oils on the changes in blood lipids.**

Voon et al. 2019
Accepted: Advances in Nutrition

SUMMARY FROM META-ANALYSIS

TC

LDL

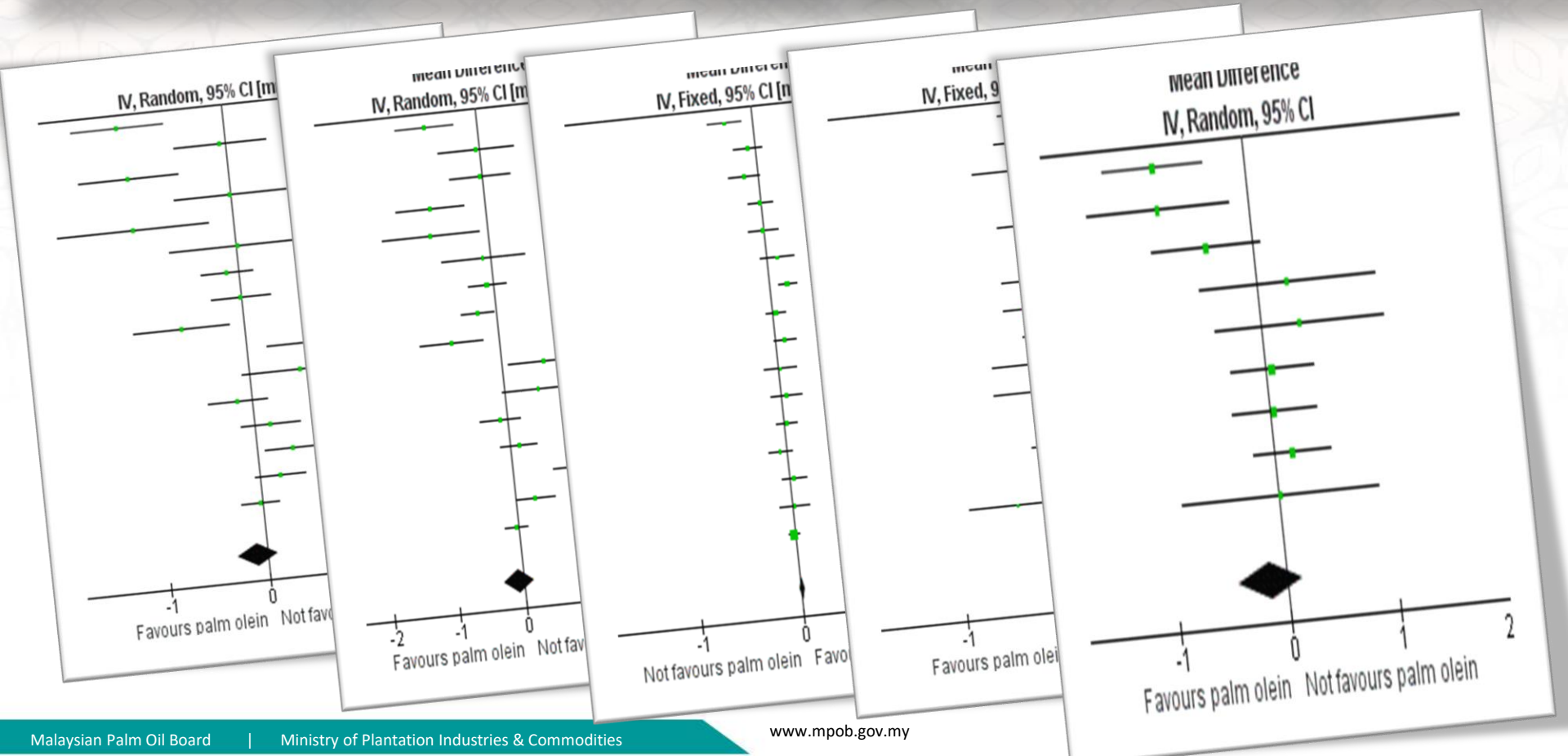
HDL

TAG

TC/HDL

Palm olein diet does not adversely affect TC, LDL, HDL TAG and TC/HDL ratio in healthy adults.

Palm olein did not show significant effect on TC, LDL, HDL, TAG and TC/HDL ratio



Studies on Palm Mid Fraction (PMF)

Dietary fats containing palmitic (PMF) and oleic acid (HOSF) at the sn-1, 3 positions of the TAG backbone

exert similar postprandial lipid and glucose responses

compared with that of a stearic acid-rich sn-1,3 dietary fat (Shea Stearin-SS).

Journal of Oil Palm Research
DOI: https://doi.org/10.21894/jopr.2020.0100

IS PALM MID FRACTION A HEALTHIER CHOICE AS A COCOA BUTTER EQUIVALENT?

VOON, P T*; TOH, S W H; NG, T K W‡; LEE, V K M**; YONG, X S**; NG, Y T* and NESARETNAM, K+**

ABSTRACT

Palm mid fraction (PMF) is a fraction of palm oil rich in 1, 3-dipalmitoyl-2- oleoylglycerol (POP) triacylglycerol (TAG) that is obtained through re-fractionation of either palm olein or palm stearin. POP-, 1(3)-1, 3 distearoyl-2-oleoylglycerol (SOS)- and triolein (OOO)- type of fats have different melting characteristics that may affect postprandial lipid and glucose metabolism. We aimed to study the effects of palmitic, stearic or oleic acid situated at the sn-1 *and* sn-3 *positions of edible fats on postprandial lipemia, glucose and insulin responses. A randomised, double-blind crossover (3 x 3 arms) orthogonal Latin-square design was used. A total of 36 healthy adults received three different test muffins, each containing 53 g of test fat from palm mid fraction (PMF as POP-rich fat), shea stearin (SS as SOS-rich fat) or high-oleic sunflower oil (HOSF as OOO-rich fat) plus a low-fat milkshake in random order separated by two weeks. No significant differences ($P>0.05$) were observed between the three test meals for postprandial responses in plasma total cholesterol, Lp(a), glucose and insulin levels. However, plasma TAG levels were found significantly higher ($P<0.05$) in PMF- and HOSF- subjects compared with SS- subjects after 90 min. Plasma C-peptide levels were found lower ($P<0.05$) in the SS-subjects compared to the PMF- and HOSF- subjects. The results suggested that dietary fats containing palmitic (PMF) and oleic acid (HOSF) at the* sn-1, 3 *positions of the TAG backbone exert similar postprandial lipid and glucose responses compared with that of a stearic acid-rich* sn-1,3 *dietary fat (SS). In the food industry, there is demand for edible fats with different forms of TAG which can serve as a cocoa butter equivalent (CBE)* i.e. *as an important alternative for chocolates and other confectionary products.*

Keywords: fatty acids, *sn*-1 and *sn*-3, postprandial lipemia, glucose, insulin.

Received: 16 July 2020; **Accepted:** 16 September 2020; **Published online:** 12 November 2020.

Studies on Palm Mid Fraction (PMF)

PMF- and HOSF-rich diets

exerted significantly higher (P<0.05) postprandial glucose dependent insulinotropic polypeptide (GIP)

compared Shea Stearin-SS.

Increased secretion of GIP - promotes satiety response

Journal of Oil Palm Research
DOI: https://doi.org/10.21894/jopr.2021.0000

DOES PALM MID FRACTION AFFECT ADULT SATIETY?

VOON, P T*; TOH, S W H**; NG, T K W‡; V K M LEE**; YONG, X S‡; YAP, S Y* and NESARETNAM, K‡‡

ABSTRACT

Dietary fats with different melting characteristics, fatty acids chain length and positional distribution may affect postprandial gut hormones and satiety response. We investigated the effects of palm mid fraction (PMF) (POP-rich), shea stearin (SS) (SOS-rich) and high oleic sunflower oil (HOSF) (OOO-rich) with either palmitic, stearic or oleic acid predominance at the sn-1 and sn-3 positions on gut hormone concentrations and satiety. A randomised, double-blind crossover (3 × 3 arms) orthogonal Latin-square study was conducted on 36 healthy adults (18 males, 18 females; average aged 23 years). Each subject received ~50 g of test fat incorporated in a muffin in random order, two weeks apart, over a six-week period. Blood samples were collected for a 3-hr period. We found that PMF- and HOSF-rich diets with either palmitic or oleic acid at the sn-1 and sn-3 positions exerted significantly higher (P<0.05) postprandial glucose dependent insulinotropic polypeptide (GIP) compared to SS-rich diet. However, plasma glucagon like-peptide 1 (GLP-1), peptide YY (PYY), ghrelin and visual analogue scale (VAS) (P>0.05) were not affected. These results suggested that PMF- and HOSF-rich diets increased the secretion of GIP that may promote satiety response in human adults.

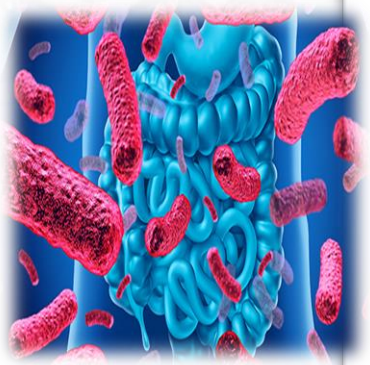
Keywords: palmitic acid, stearic acid, gut hormone, glucose dependent insulinotropic polypeptide, glucagon like-peptide 1, peptide YY, ghrelin, satiety.

Received: 29 September 2020; **Accepted:** 3 February 2021; **Published online**:

Studies on Palm Oil and Gut Microbiota

There is an abundance of specific bacteria after consuming various dietary fats and

the findings proposes a potential bacteria profile following the palm oil diet.



Journal of Oil Palm Research
DOI: https://doi.org/10.21894/jopr.2021.0004

ASSOCIATION OF DIETARY FATS WITH GUT MICROBIOTA PROFILE: HOW DOES PALM OIL FIT IN?

S Y YAP*; P T VOON*; Y K CHEAH**; V K M LEE[1] and SELVADURAY, K R*

ABSTRACT

Diet manipulation alters the gut microbiota composition. Gut dysbiosis is characterised by imbalanced bacteria composition that has been associated with high fat diet. Diets containing high animal fat induce pathogenic bacteria growth and similar bacterial profiles have been identified in obese adults and chronic disease patients. Conversely, diets containing high plant fat increase the abundance of beneficial bacteria. Habitual fat intakes modulate the bacterial species and their metabolites in different geographical locations and ethnicities. Dietary interventions using various degrees of fatty acid saturation reported reduced bacterial diversity in high saturated fatty acid (SFA) diet and increased in high monounsaturated fatty acid (MUFA) diet. However, high polyunsaturated fatty acid (PUFA) diet demonstrated a wide variation in bacterial diversity. These results suggested that the effects of dietary fats on gut microbiota composition are not fully established. Palm oil has almost balanced proportions of saturated and unsaturated fatty acids coupled with unique stereo-specificity fatty acids compositions and nutritional properties, making it the main vegetable oil in the Malaysian diet. However, its effect on the gut microbiota profile is still unknown. This review highlights the abundance of specific bacteria after consuming various dietary fats and proposes potential bacteria profile following the palm oil diet.

Keywords: gut microbiota, dysbiosis, palm oil, dietary fats.

Received: 3 September 2020; **Accepted:** 12 November 2020; **Published online:** 16 February 2021.

Studies on Palm Oil and Gut Microbiota

RESEARCH ARTICLE

European Journal of Lipid Science and Technology
www.ejlst.com

Different Ratios of Corn and Coconut Oil Blends in High-Fat Diets Influence Fat Deposition without Altering Metabolic Biomarkers in Male Rats

Phooi Tee Voon, Xiou Shuang Yong, Lai Yee Phang, Tong Kok Wai Ng, and Verna Kar Mun Lee*

The effects of high-fat diets with the recommended dietary linoleic acid (LA) intake levels on health outcomes have not been studied extensively. This study investigated the effects of high-fat diets containing different weight ratios of coconut and corn oil with LA levels of <1.00% of energy (very low LA), 2.80% of energy (low LA), 5.80% of energy (moderate LA), and 9.70% of energy (high LA) on fat deposition and selected metabolic biomarkers of male Sprague-Dawley rats. Their initial and terminal body weights are recorded. Blood, adipose tissue, and liver samples are obtained for analysis after an 8-week feeding intervention. Compared with the very low-LA diet, the high-LA diet resulted in higher body weight gain and epididymal fat deposition. No significant differences are observed in liver-to-body weight ratio, blood glucose, visfatin, and leptin levels between the test diets. Serum tumor necrosis factor-alpha (TNF-α), insulin, and C-peptide levels do not significantly increase with the increase in dietary LA levels. High-LA diet results in higher LA levels in the liver and adipose tissue. It is concluded that a high-fat diet containing high LA levels induced body weight gain and epididymal fat deposition in rats but has no effect on selected metabolic biomarkers.

Practical applications: Linoleic acid (LA) (C18:2) plays an important role as one of the nutritional elements to meet the daily essential fatty acid requirements. However, a full understanding is perplexed by the various ways that LA can be included in the diet when there is a recommendation to substitute saturated fatty acid (SFA), trans- or n-3 fatty acids intake. The data provide additional findings on the effects of excessive dietary intake of LA (C18:2) on fat deposition when different levels of SFAs are replaced.

1. Introduction

The obesity epidemic began in most high-income countries especially in the 1970s and 1980s.[1,2] Obesity has surpassed malnutrition and infectious diseases as the most significant contributor to ill health worldwide.[3,4] When a population achieves affluence, their intake of energy, fat, and sugar increases, as indicated by the increasing and now substantial food importation bills.[5,6] Changes in the global food system are the primary driving force for increasing obesity.[2,6,7]

Studies have demonstrated that the intake of linoleic acid (LA) rich diet induces obesity.[8–10] The soybean–coconut oil diet was found to produce significantly more adipose tissue than the coconut oil-only diet but without any significant effect on liver weight.[11] An increase in the mean adipocyte size and pre-adipocyte replication are the main causes of increased epididymal fat deposition and obesity.[12,13] Medium-chain fatty acids (MCFA), mainly found in coconut oil, are highly vulnerable to oxidative reactions, resulting in high energy expenditure and reduction in the adipocyte size in animals.[14]

Polyunsaturated fatty acid (PUFA) was found to stimulate satiety signals and can be utilized readily, leading to lower fo

High-linoleic acid (LA) diet results in higher LA levels in the liver and adipose tissue.

A high-fat diet containing **high LA levels induced body weight gain and epididymal fat deposition** in rats but has no effect on selected metabolic biomarkers.

Palm Oil is Rich in Healthful Phytonutrients

Phytonutrients	Concentration (ppm)
Vitamin E (tocotrienols, tocopherols)	600-1000
Carotenoids (α-carotene, β-carotene, lycopene, phytoene)	500-700
Phytosterol (Sitosterol, stigmasterol, campesterol)	300-620
Squalene	250-540
Lecithin (Phospholipids)	20-100
Co-enzyme Q10 / Ubiquinones	10-80
Polyphenols (phenolic acids, flavonoids)	40-70

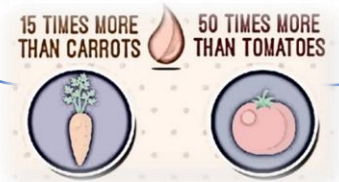
Source : Choo *et.al.*, 2008

Palm oil – Nutritious and Functional

Red palm oil is an excellent source of **Vitamin E** and **Carotene** (Pro-Vitamin A)

Palm Vitamin E consist of **75-80% tocotrienols** and 20-25% tocopherols (the reason why palm Vitamin E known as Tocotrienol-Rich Fraction, TRF).

Red palm oil contains 50 times more carotenes than tomatoes & 15 times more than carrots



Palm micronutrients have myriad of health enhancing benefits .e.g., Vitamin E – antioxidant effects, cholesterol lowering and possible anti-cancer activities.

Palm Fruit, Rich in phytonutrients

Vitamin E (Tocotrienols & Tocopherols)

Carotene from Red Palm Oil

- Squalene
- Lecithin
- Coenzyme Q_{10}
- Phytosterol

Choo et. *al.* 2008

Health Benefits of Tocotrienols

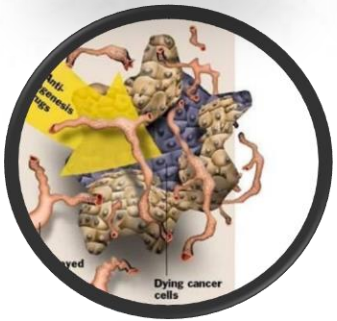
Neuroprotection
(Sen et al.,1999)

Radioprotection
(Singh et al., 2016)

Cardiovascular prevention
(Das et al., 2008)

Antioxidant
(Theriault et al.,1999)

Bone protection
(Shen et al., 2017)



Cancer prevention
(Selvaduray et al., 2010)

Immune booster
(Radhakrishnan et al., 2014)

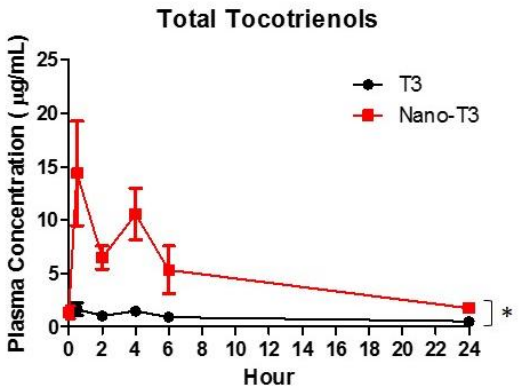
Skin protection
(Yap, 2018)

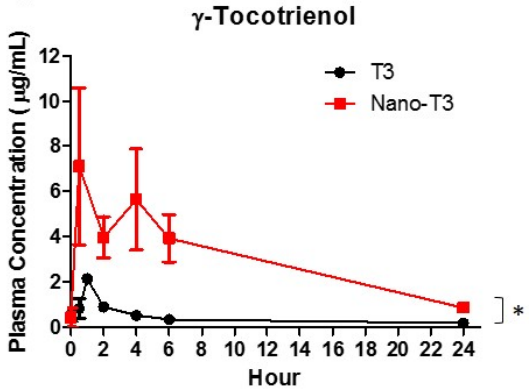
Anti-inflammation
(Yam et al., 2009

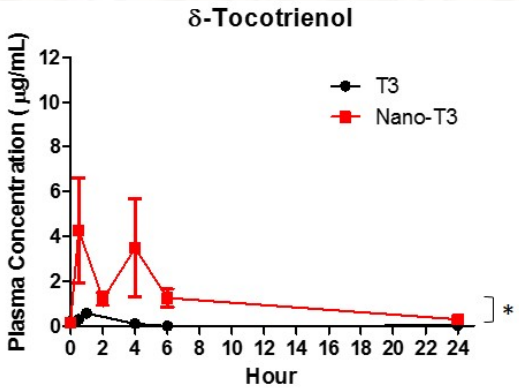
Hormone regulator
(Saito et al., 2003)

Nano-Tocotrienols

Enhanced Bioavailability







Relative bioavailability, *F*

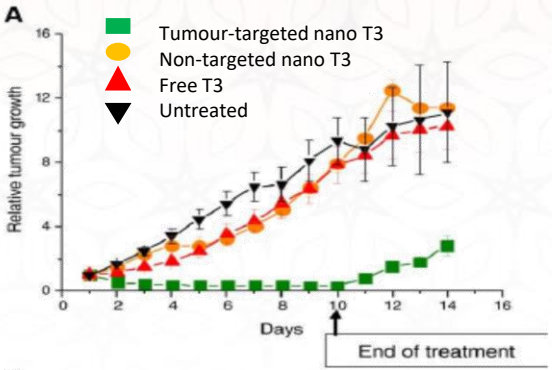
Stereoisomer		AUC $_{0\text{-}24}$ (µg/ml*hour)	F (%)
α-tocotrienol	Test	51.97 ± 18.60	403
	Reference	12.90 ± 1.41	
γ-tocotrienol	Test	69.77 ± 9.48	829
	Reference	8.42 ± 3.26	
δ-tocotrienol	Test	26.66 ± 0.79	1374
	Reference	1.94 ± 1.08	

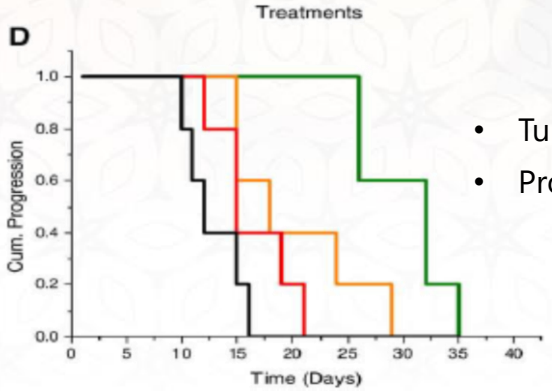
1. **Higher plasma concentration**
2. **Prolonged circulation time**

Fu et al., AOCS. 2021

Nano-Tocotrienols

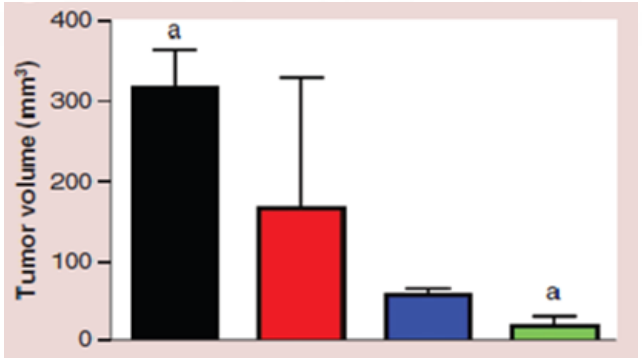
Cancer Management





- Tumour suppression up to 10 days
- Prolonged survival of 19 days

Fu et al., J Controlled Release. 2009

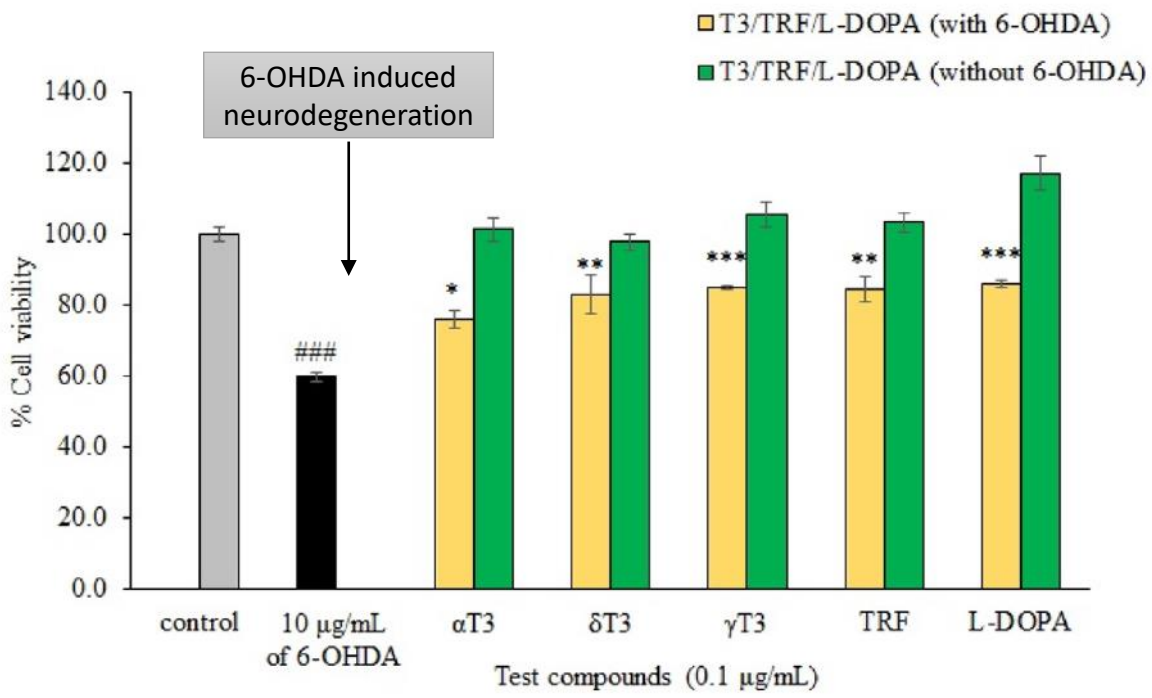


Tumour-targeted nano-T3
Free T3
Nano-T3
Untreated

- 12-fold reduction in tumour volume was observed in mice treated with tumour-targeted nano-T3

Tan et al., Nanomedicine. 2017

ROLE OF TOCOTRIENOLS IN PARKINSON'S DISEASE

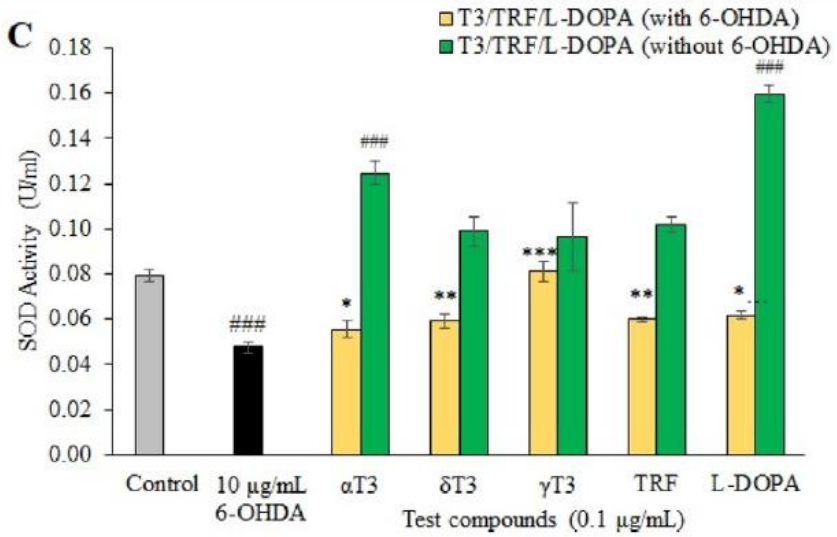


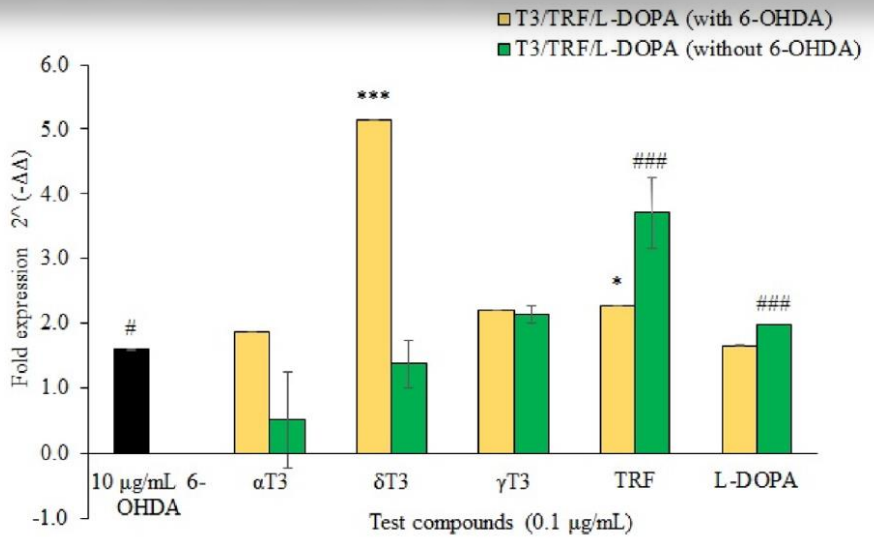
Pre-treatment of tocotrienols restored cell viability in differentiated SH-SY5Y neural cells.

Significant difference observed in cells pre-treated with tocotrienols compared to positive control (6-OHDA group).

(Magalingam et al., 2022. Nutrition Research)

ROLE OF TOCOTRIENOLS IN PARKINSON'S DISEASE





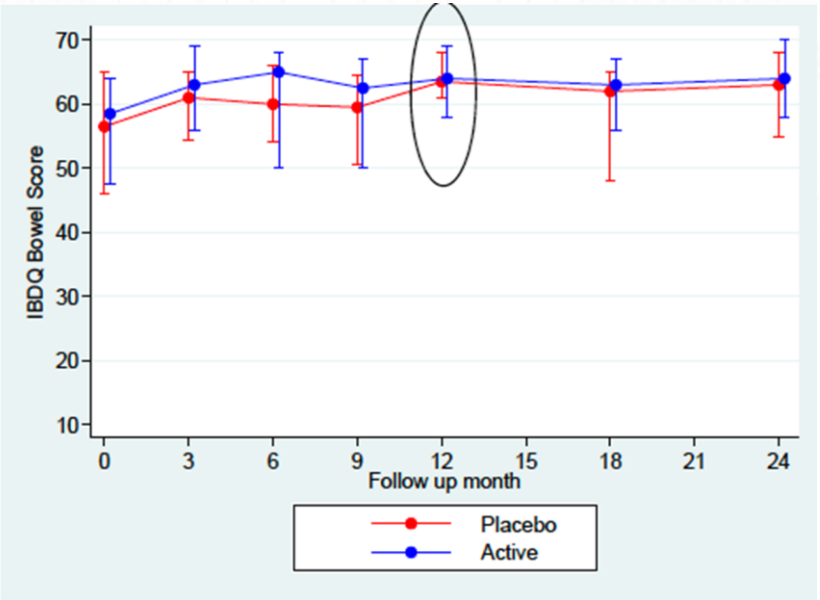
Elucidation on mechanism of action showed significant activation of antioxidant enzyme (SOD activity) in cells pre-treated with tocotrienols.

Dopamine receptor D2 (DRD2) manifests motor systems and was found to be down-regulated in Parkinson's disease. Tocotrienols mediated the overexpression of DRD2 genes compared to 6-OHDA group.

(Magalingam et al., 2022. Nutrition Research)

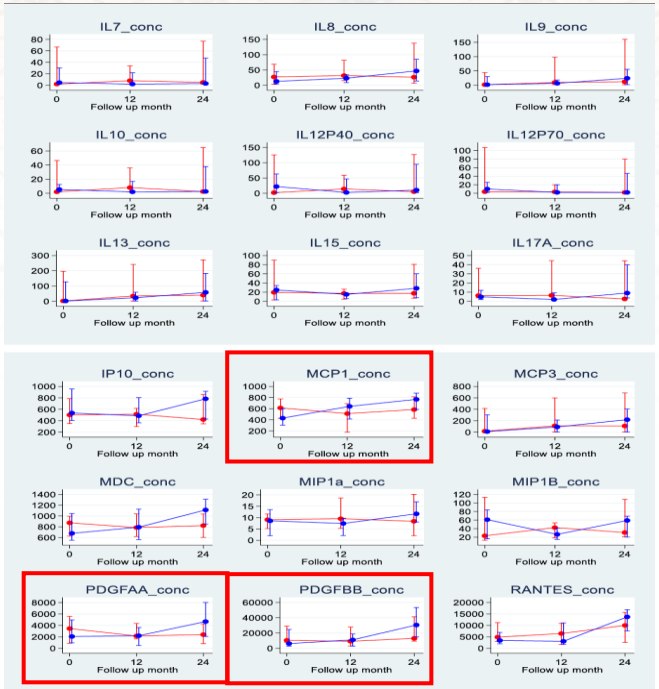
PPALM STUDY

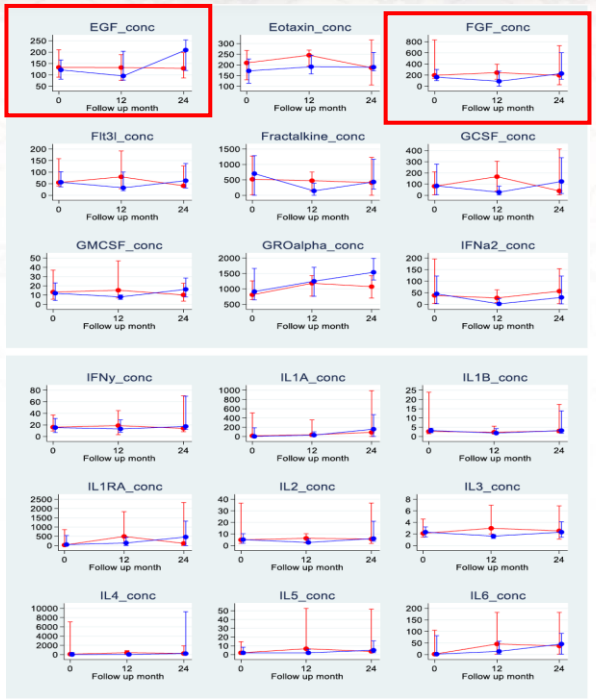
A randomised double-blind placebo controlled phase II trial of Tocovid SupraBio in combination with pentoxifylline in patients suffering long-term gastrointestinal adverse effects of radiotherapy for pelvic cancer ()



(Andreyev, H. J. N et al., 2022; *Radiotherapy and Oncology*, *168*, 130-137)

Serum fibrotic marker analysis



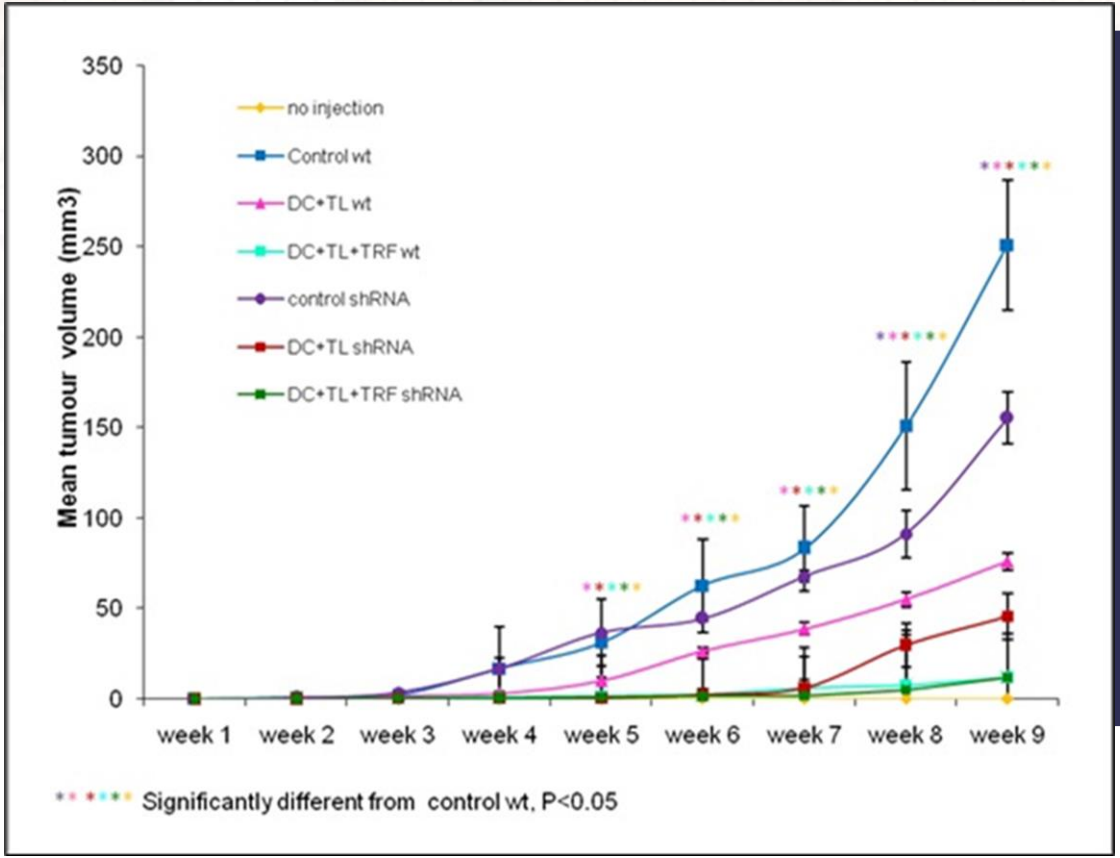


Tocotrienols exhibit anti-inflammatory and anti-fibrotic effects

(Andreyev, H. J. N et al., 2022; *Radiotherapy and Oncology*, *168*, 130-137)

Tocotrienols as an adjuvant in breast cancer immunotherapy

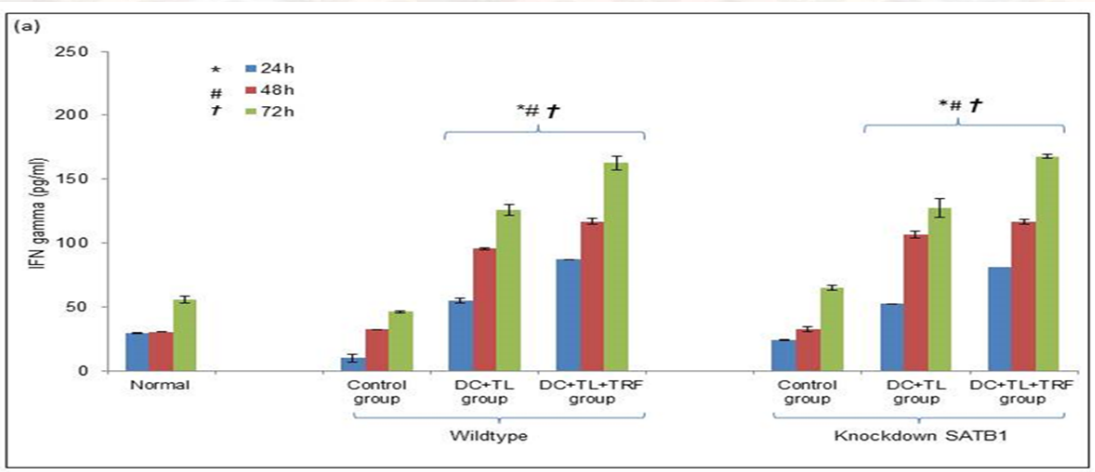
Tocotrienols significantly inhibited and reduced tumour volume in mice injected with 4T-1 tumour cells

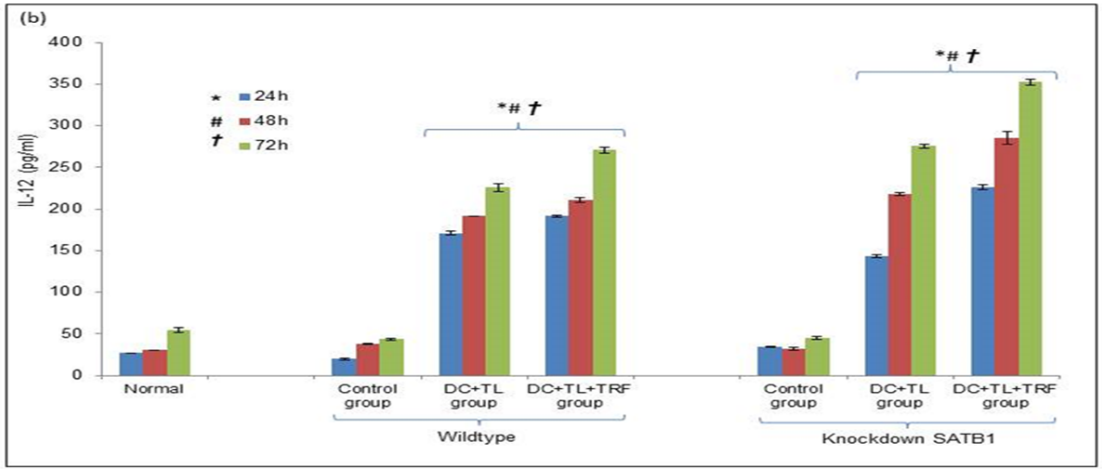


ABDUL HAFID, S. R. ., & RADHAKRISHNAN, A. K. . (2021). ELUCIDATING THE ROLE OF THE SATB1 GENE IN BREAST CANCER CARCINOGENESIS IN THE PRESENCE OR ABSENCE OF TOCOTRIENOL-RICH FRACTION: EVIDENCE FROM A SYNGENEIC MOUSE MODEL OF BREAST CANCER. *Malaysian Applied Biology*, *50*(3), 145–161. https://doi.org/10.55230/mabjournal.v50i3.2087

Tocotrienols as an adjuvant in breast cancer immunotherapy

Tocotrienol supplementation significantly increased levels of IFN-γ and IL-12 in mice





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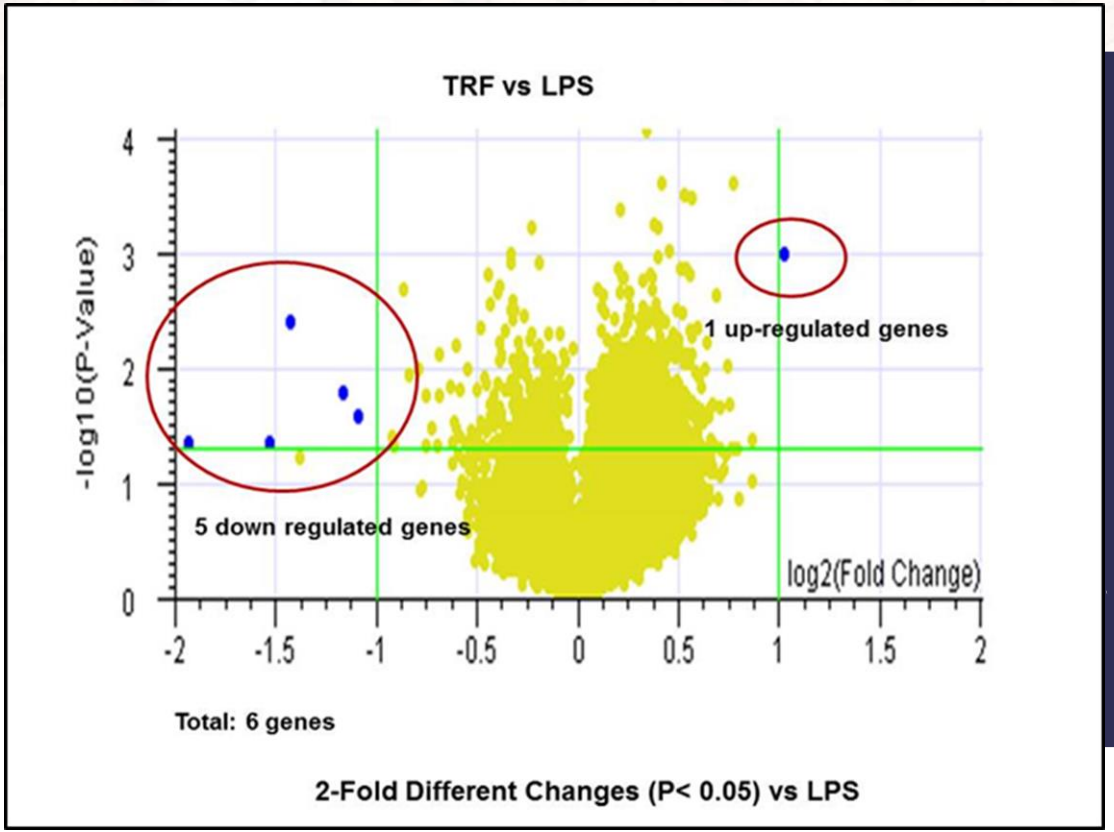
Tocotrienols and inflammation

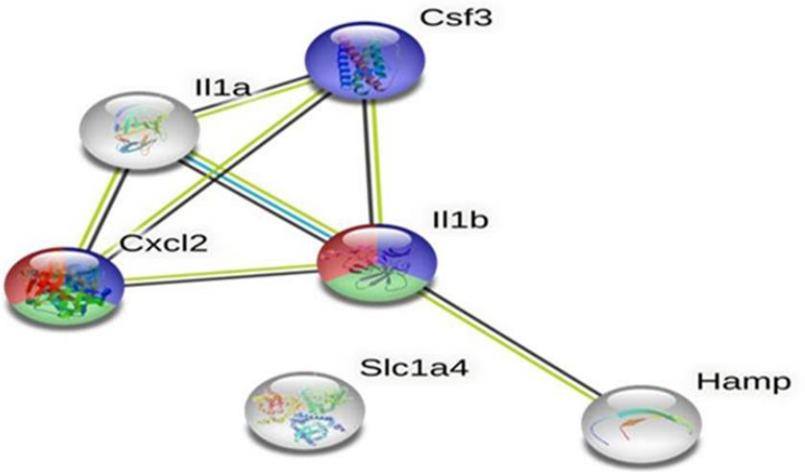
Analysis of the microarray data showed that six differentially regulated genes in LPS-stimulated macrophages RAW 264.7 cells treated with TRF, where the one gene (*SLCLA4*) was upregulated and five genes (*Hamp, IL-la, IL-1b CXCL2* and *CSF3*) were downregulated when compared to LPS-alone group. These genes were mainly involved in mediating inflammatory processes.



Hafid, S. R. A., Aini, M. A. M., Iran, N., Norisam, I., Radzun, K. A., & Radhakrishnan, A. K. (2021). Tocotrienol-rich Fraction Modulated Genes Responsible for Inflammation in Lipopolysaccharide-stimulated RAW 264.7 Macrophages. *Journal of Pharmaceutical Research International*, *33*(54B), 106-118. https://doi.org/10.9734/jpri/2021/v33i54B33771

Tocotrienols and inflammation

TRF possesses anti-inflammatory properties and downregulated genes responsible for acute and chronic inflammations. The results of this study suggested that TRF inhibited both LOX and COX in the inflammatory pathways proposing that through supplementation of TRF in RAW 264.7, macrophages would inhibit inflammatory genes via biological processes, interactions of TNF and NF-kB, as well as through inflammatory mediators such as IL-1 and IL-17.



Pathway	KEGG Pathways	Colour Indication
mmu04657	IL-17 Signaling Pathway	
mmu04064	NF-kappa B Signaling Pathway	
mmu4668	TNF Signalling Pathway	

Hafid, S. R. A., Aini, M. A. M., Iran, N., Norisam, I., Radzun, K. A., & Radhakrishnan, A. K. (2021). Tocotrienol-rich Fraction Modulated Genes Responsible for Inflammation in Lipopolysaccharide-stimulated RAW 264.7 Macrophages. *Journal of Pharmaceutical Research International*, *33*(54B), 106-118. https://doi.org/10.9734/jpri/2021/v33i54B33771

Health Benefits of Red Palm Oil

- Red palm oil is a refined oil that is rich in carotenes e.g. α-carotene, β-carotene and lycopene
- Contains 13 other carotenes, tocopherols and tocotrienols, CoQ10, phytosterols, glycolipids

Benefits of Carotenes in red palm oil

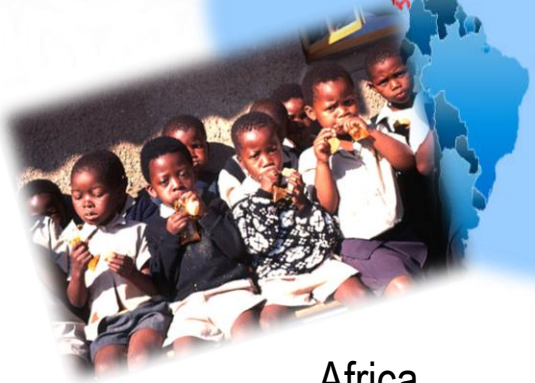
- Prevention of cardiovascular diseases
- Immuno-enhancement
- Prevention of macular degeneration
- Decrease risk of cataract formation
- Inhibition of cancer

Red Palm Oil Supplementation Programme in School Children

- **Reduction in Vitamin A Deficiencies**
- **Improvement in eye related diseases**

India

China



Africa

Malaysia

Tan et al., 2022

British Journal of Nutrition, page 1 of 14 doi:10.1017/S0007114522001398

High prevalence of malnutrition and vitamin A deficiency among schoolchildren of rural areas in Malaysia using a multi-school assessment approach

Pei Yee Tan[1,2], Syahirah Nadiah Mohd Johari[2], Kim-Tiu Teng[1]*, Radhika Loganathan[1], Soo Ching Lee[3], Romano Ngui[2], Kanga Rani Selvaduray[1] and Yvonne Ai Lian Lim[2]*

[1]*Nutrition Unit, Division of Product Development and Advisory Services, Malaysian Palm Oil Board, No. 6, Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia*
[2]*Department of Parasitology, Faculty of Medicine, Universiti Malaya, Kuala Lumpur 50603, Malaysia*
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(Submitted 4 January 2022 – Final revision received 1 April 2022 – Accepted 19 April 2022)

Abstract

Childhood malnutrition is known as a public health concern globally. The present study aims to assess the anthropometry and blood biochemical status of rural primary schoolchildren in Malaysia. A total of 776 children (7–11 years old) from ten rural primary schools from five states were included in this study. Nutritional outcomes were assessed based on sex, age group and school categories among the children (median age: 9 years (P25:8, P75:10)). The overall prevalence of malnutrition was 53·4 %. Vitamin A deficiency (VAD) was recorded at 20·6 and 39·8 % based on retinol and retinol-binding protein (RBP) levels, respectively. Anaemia, iron deficiency (ID), iron-deficiency anaemia (IDA) and elevated inflammation were found at 14·9, 17·9, 9·1 and 11·5 %, respectively. Malnutrition, VAD, anaemia, ID, IDA and elevated inflammation were more prevalent among Orang Asli (OA) schoolchildren compared with Non-Orang Asli schoolchildren. Higher occurrences of VAD and anaemia were also found among children aged <10 years. Retinol, RBP, α-carotene, ferritin and haemoglobin levels were lower among undernourished children. Besides, overweight/obese children exhibited a higher level of high-sensitivity C-reactive protein. Multivariate analysis demonstrated that OA school children (adjusted OR (AOR): 6·1; 95 % CI 4·1, 9·0) and IDA (AOR: 3·6; 95 % CI 1·9, 6·6) were associated with stunting among this population. The present study revealed that malnutrition, micronutrient deficiencies and anaemia are prevalent among rural primary schoolchildren in Malaysia, especially those from OA schools and younger age children (<10 years). Hence, more appropriate and targeted measures are needed to improve the nutritional status of these children.

Keywords: **Malnutrition: Vitamin A deficiency: Anaemia: Iron Deficiency: Inflammation**

British Journal of Nutrition

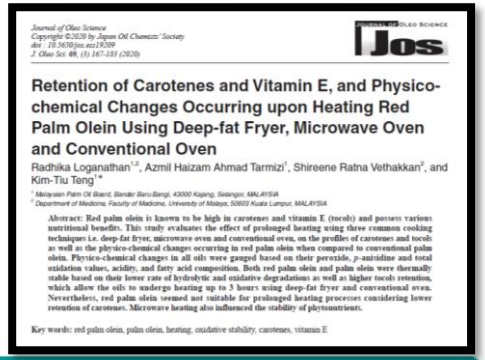
Malnutrition, micronutrient deficiencies and anaemia are still prevalent among rural primary school children in Malaysia

Is red palm oil suitable for normal cooking practices?

Red oil palm is suitable for common cooking practices but may not be suitable for longer heating processes as carotene retention is of concern (Loganathan *et al.*, 2020).

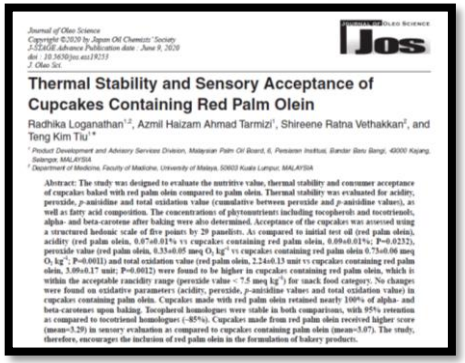
Sauté ✓ | **Stir-fry ✓** | **Roast ✓** | **Bake ✓**

Light Microwave ✓ | **Deep Frying X**



Retention of Carotenes and Vitamin E, and Physico-chemical Changes Occurring upon Heating Red Palm Olein Using Deep-fat Fryer, Microwave Oven and Conventional Oven

Radhika Loganathan[1,2], Azmil Haizam Ahmad Tarmizi[1], Shireene Ratna Vethakkan[2], and Kim-Tiu Teng[1,*]



Thermal Stability and Sensory Acceptance of Cupcakes Containing Red Palm Olein

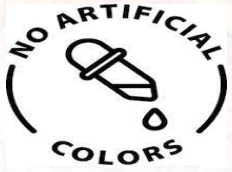
Radhika Loganathan[1,2], Azmil Haizam Ahmad Tarmizi[1], Shireene Ratna Vethakkan[2], and Teng Kim Tiu[1,*]

How do I incorporate red palm oil in my diet?

Consume directly

Cooking oil

Bakery fats



Natural colorant

Salad dressing

Seasoning

Good oil storage practices at home to maintain the oil quality

Away from heat

Not near the stove!

Away from light

Don't place it on your kitchen bench or near the window facing direct sunlight

Store it inside your kitchen kabinet

(Away from heat and light)

Journal of Oleo Science
Copyright ©2020 by Japan Oil Chemists' Society
doi : 10.5650/jos.ess20036
J. Oleo Sci. **69**, *(10) 1163-1179 (2020)*

Storage Stability Assessment of Red Palm Olein in Comparison to Palm Olein

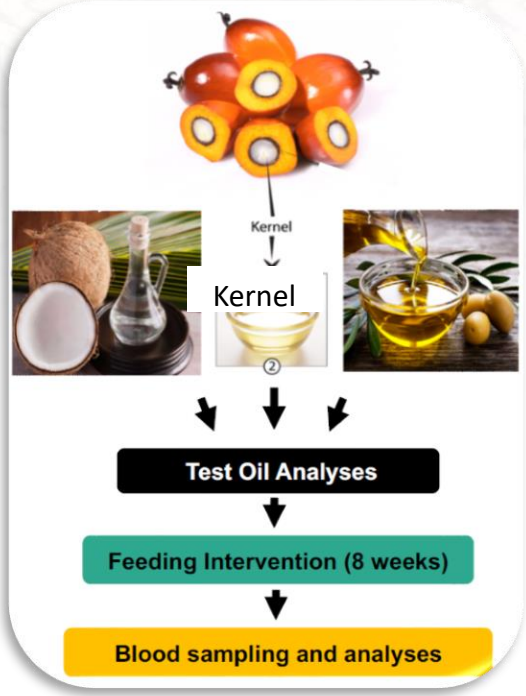
Radhika Loganathan[1, 2], Azmil Haizam Ahmad Tarmizi[1], Shireene Ratna Vethakkan[2], and Kim-Tiu Teng[1]*

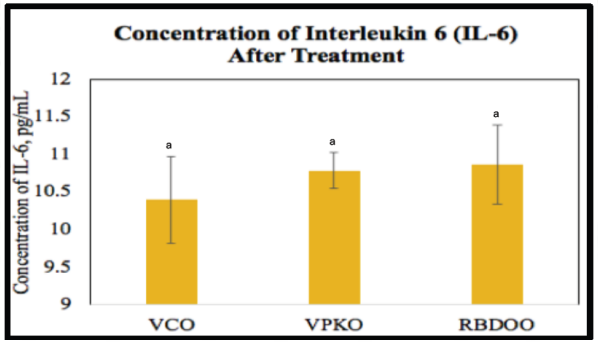
[1] *Product Development and Advisory Services Division, Malaysian Palm Oil Board, 6, Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, MALAYSIA*
[2] *Department of Medicine, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, MALAYSIA*

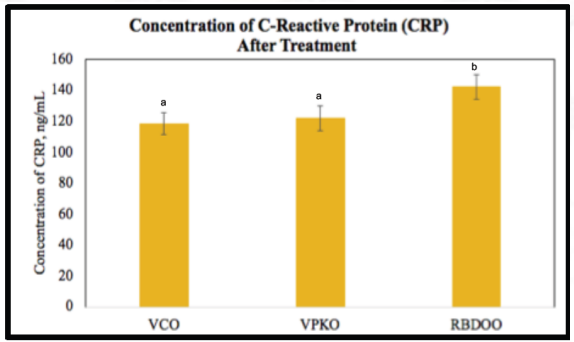
Abstract: Sixty-four bottles of red palm olein and palm olein (constituted as control) samples were stored at permutations of common home setting variables which are: temperature (room temperature (24℃) or 8℃), light (kept in dark or exposure under light) and oxygen (opened or sealed caps). The effects of temperature, oxygen and light on the stability of red palm olein and palm olein were studied over 4 months of storage at simulated domestic conditions. The degree of auto- and photo-oxidations was evaluated by monitoring the following quality parameters: acidity, peroxide and *p*-anisidine values, fatty acids composition, carotenes and vitamin E. It is noted from the study that opened bottles of red palm olein was found to be stable for 4 months in comparison to its counterpart (palm olein) evidenced from their primary oxidative constituents (peroxides) and hydrolytic behavior (free fatty acids). Opened bottles are better off when stored at 8℃ and protected from light for a longer shelf-life. Sealed bottles of palm olein showed better storage stability in the

Studies on Palm Kernel Oil

A comparative study on the effects of virgin palm kernel olein and virgin coconut oil on biomarkers of immune function, inflammation, and oxidative stress in male Sprague-Dawley rats







Conslusion:

VPKO could be a potential supplement as an alternative to VCO for relieving inflammation and enhancing body immune system.

Take Home Messages

- ***Opinion on saturated fats is changing***
- ***No association between saturated fat intake and CVD***
- ***Palm oil and Red Palm Oil are nutritious***
- ***Numerous food uses***
- ***Good functional properties and is versatile***
- ***Rich in health beneficial phytonutrients***
- ***Non GMO***
- ***Palm oil is the best substitute for trans fat***
- ***Say No to trans fats***
- ***PMF and PKO have potentials for further exploration***
- ***Palm oil contributes towards the world's nutritional needs***

Say Yes to Palm Oil !!

THANK YOU

- Nutrition Society of Malaysia
- Director General, Malaysian Palm Oil Board
- Director, PDAS Division, MPOB
- Head, International Trade Unit, MPOB
- Officers, Nutrition Unit, MPOB

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