Majalah Sawit Indonesia
Jakarta, 6 Maret 2019

Palm Oil Benefits for Health

Nuri Andarwulan
SEAFAST Center, IPB
Southeast Asian Food & Agr. Sci & Tech Center
Dept of Food Science & Technology, IPB

Info Sawit
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Minyak Sawit & Manfaatnya untuk Kesehatan

Nuri Andarwulan
SEAFAST Center, IPB
Southeast Asian Food & Agr. Sci & Tech Center
Dept of Food Science & Technology, IPB

Agenda

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Asupan Lemak & Manfaatnya

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Karakteristik Kimia Minyak Sawit

1

Proses Pengolahan Migor Sawit

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1. Proses Pengolahan Minyak Sawit

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CPO (Crude Palm Oil)

Tandan Buah Segar (TBS)

↓

Pemanasan

↓

Pengepresan

↓

Minyak Sawit Kasar (CPO)

Warna Merah Tua
Kaya Mikronutrient:
- Karotenoid
- Tokoferol
- Tokotrienol
- Fitosterol

"Perlu dimurnikan"

CPO (Minyak Sawit Kasar)

Kaya akan Mikronutrien

- Karotenoid (provitamin A)
- Tokoferol (Vitamin E)
- Tokotrienol
- Sitosterol

Warna Merah Kecoklatan

Proses Standard Pengolahan CPO Menjadi Minyak Goreng

CPO

↓

Degumming

↓

Pemucatan

↓

Deodorisasi

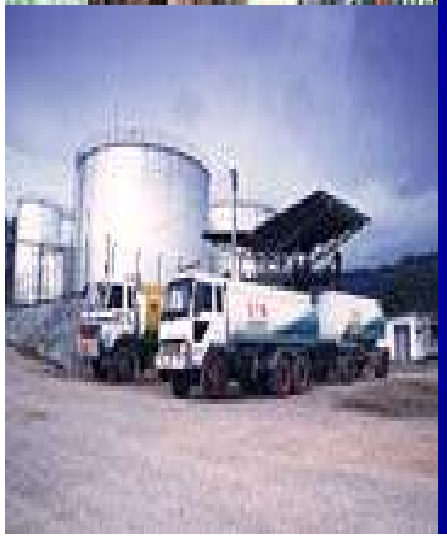
↓

RBDPO

↓

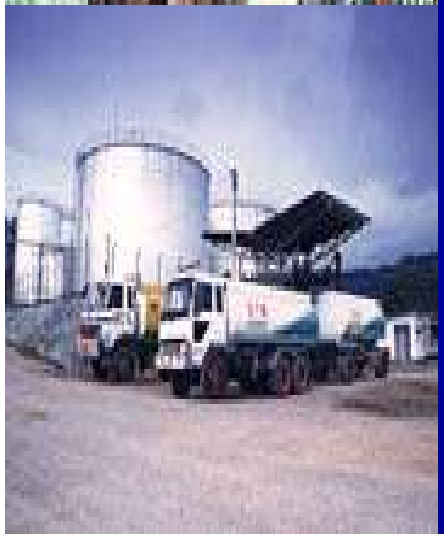
Fraksinasi

Olein ← → Stearin



Degumming

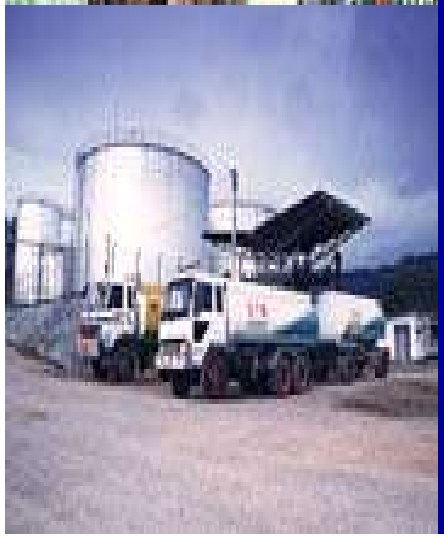
Menghilangkan kotoran-kotoran
yang berpengaruh
terhadap mutu produk akhir
minyak goreng



Bleaching / Pemucatan

Proses pemucatan warna minyak sawit dengan menggunakan bahan pemucat

- Warna Merah kecoklatan
- CPO mengandung karotenoid sangat tinggi >600 ppm
- Konsumen ingin warna pucat



Deodorisasi

Penghilangan asam lemak bebas dan senyawa yang menyebabkan bau menyimpang (*off odor*)

Asam lemak bebas

- **mudah dioksidasi dan menurunkan titik asap**

Peroksida

- **menyebabkan ketengikan minyak dan mengganggu kesehatan**

RBDPO

(Refined, Bleached,Deodorized Palm Oil)

- Warna Pucat (tergantung proses)
- Asam lemak bebas maks 0.1%
- Bilangan Peroksida 0
- Kadar Air maks 0.1%

Fraksinasi (Penyaringan)

Olein

Stearin

- Bertujuan untuk memisahkan fraksi olein dan stearin
- Fraksi olein digunakan untuk minyak goreng botol
- Fraksi stearin untuk margarin dan pemakaian industri

Proses Standard Pengolahan CPO Menjadi Minyak Goreng

1 CPO
2.CP Olein
3. CP Stearin
4. RBD Olein
5. RBD Stearin
6. RBD PO

2. Karakteristik Kimia Minyak Sawit

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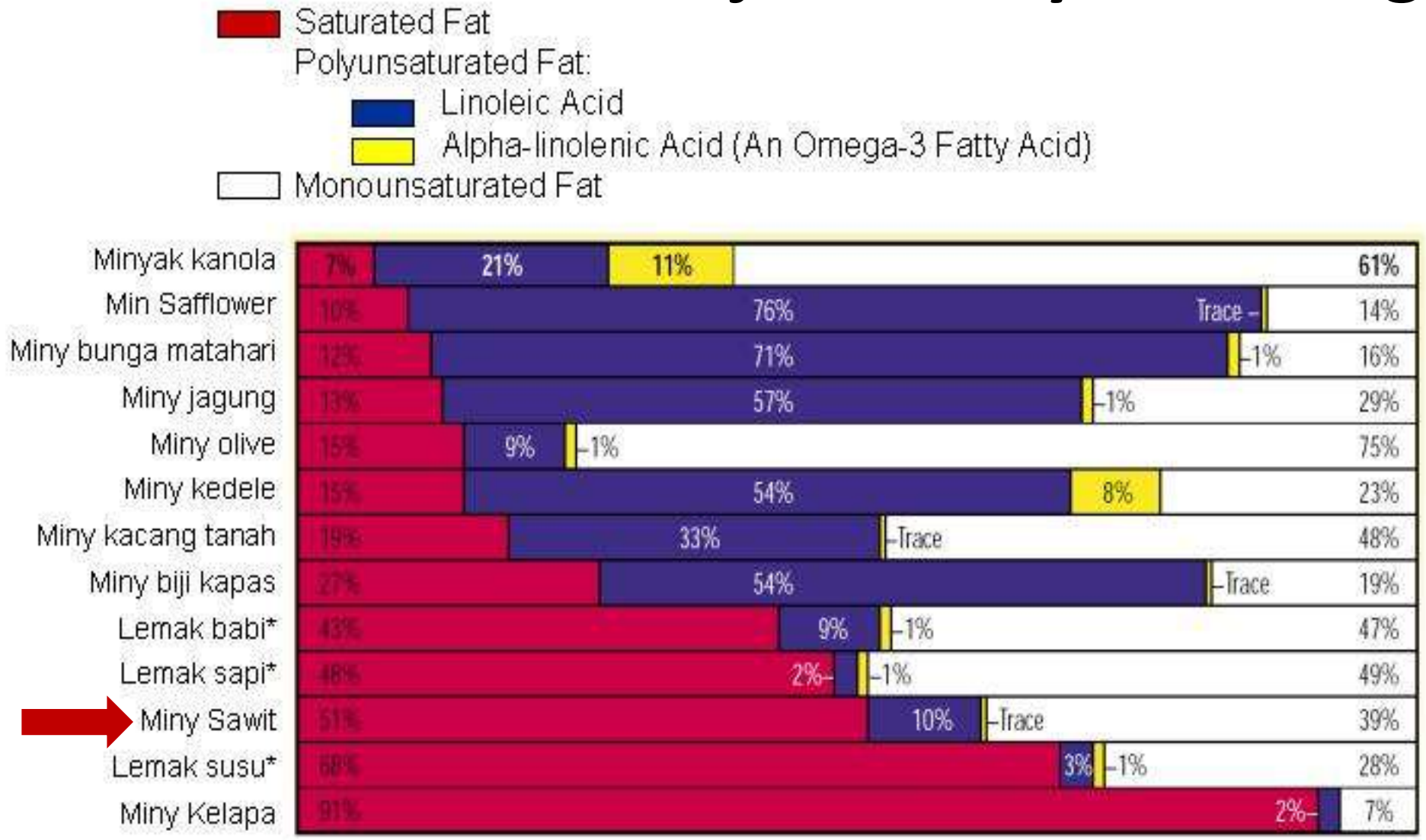
Jenis-jenis Minyak Goreng

Jenis Minyak	MUFA	PUFA	SFA
Sawit	40%	10%	50%
Kacang Tanah	39%	42%	19%
Mentega	30%	4%	66%
Jagung	30%	54%	16%
Kedele	25%	60%	15%

Jenis-jenis Minyak Goreng



*) Cholesterol Content (mg/Tbsp): Lard 12; Beef tallow 14; Butterfat 33. No cholesterol in any vegetable-based oil. Source: POS Pilot Plant Corporation, Saskatoon, Saskatchewan, Canada, June 1994

Fatty Acids of Palm Oil

Table 1. Typical fatty acid composition (%) of palm oil

Fatty acid chain length	Mean	Range observed	Standard deviation
12:0	0.3	0 - 1	0.12
14:0	1.1	0.9 – 1.5	0.08
16:0	43.5	39.2 – 45.8	0.95
16:1	0.2	0 – 0.4	0.05
18:0	4.3	3.7 – 5.1	0.18
18:1 (n-9)	39.8	37.4 – 44.1	0.94
18:2 (n-6)	10.2	8.7 – 12.5	0.56
18:3	0.3	0 – 0.6	0.07
20:0	0.2	0 – 0.4	0.16

Sundram et al, *Asia Pacific J Clin Nutr* (2003)

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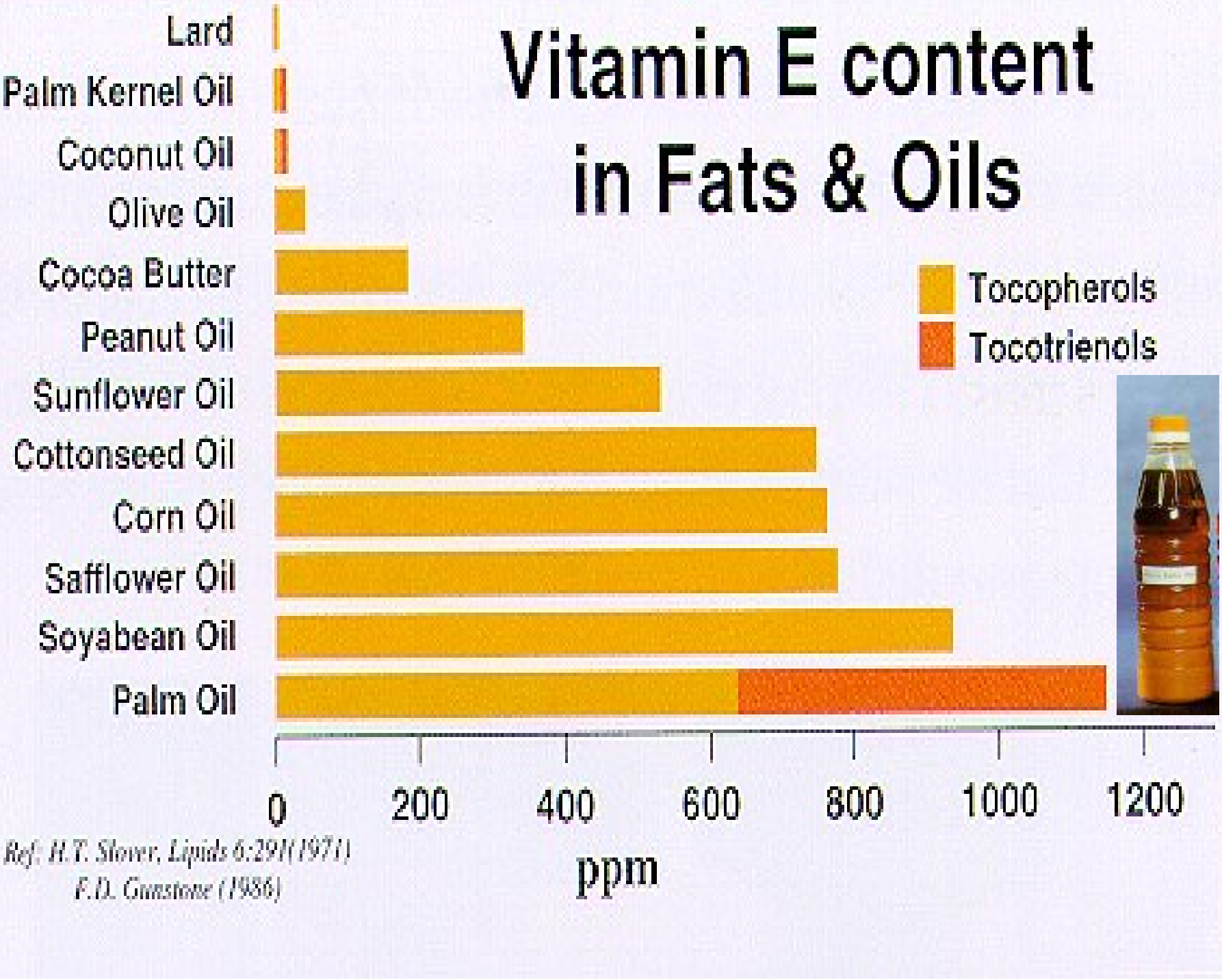
Vitamin E content in Fats & Oils



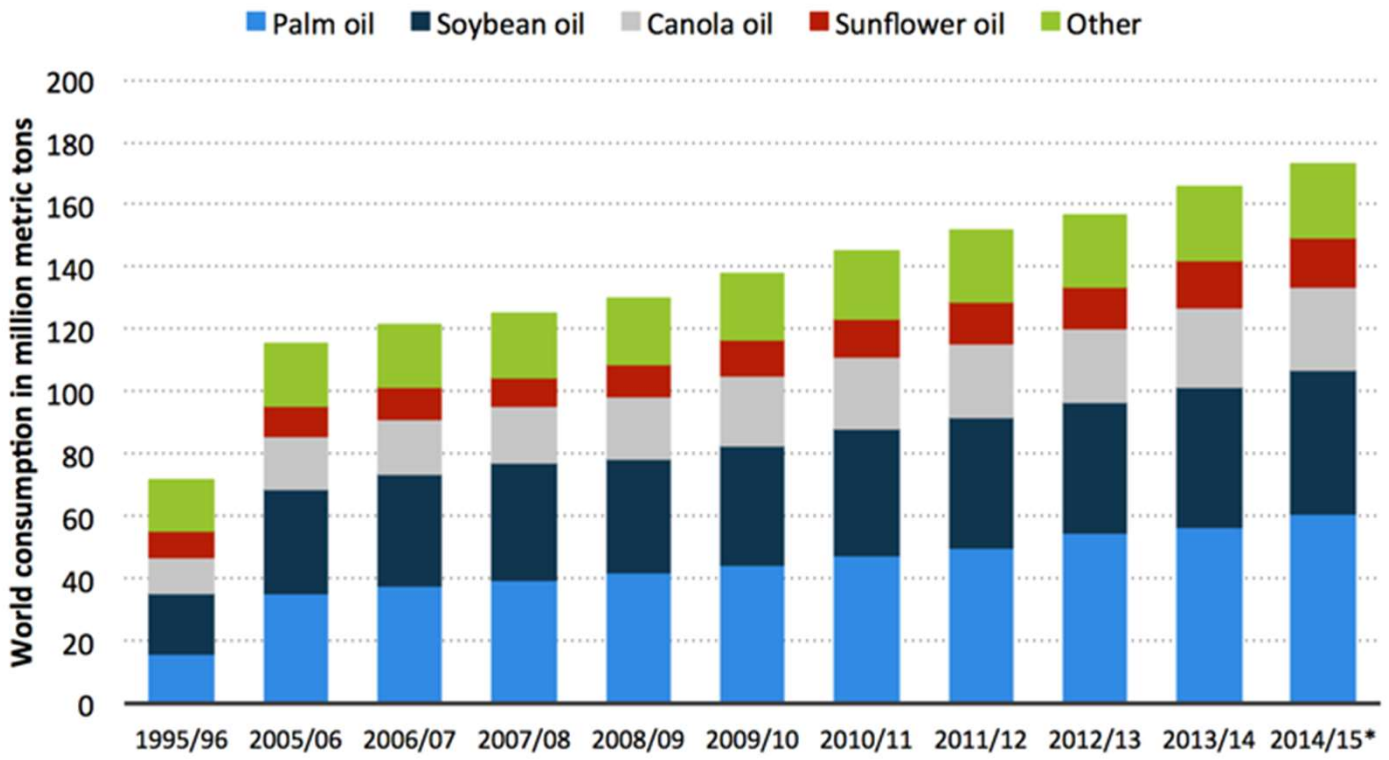
Ref: H.T. Slover, Lipids 6:291(1971)
F.D. Gunstone (1986)

3. Asupan Lemak dan Manfaatnya

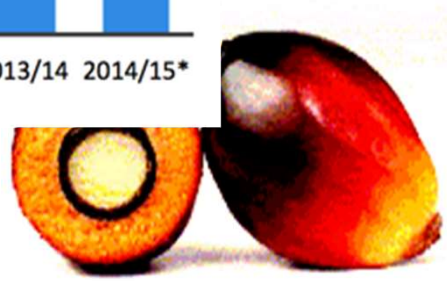
Continuous rise in palm oil consumption

Vegetable oils: global consumption by oil type 1995-2015

Global consumption of vegetable oils from 1995 to 2015, by oil type (in million metric tons)



USDA (2015)



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3. Asupan Lemak dan Manfaatnya

GULA	SODIUM	LEMAK
> 50 gram	> 2000 miligram	> 67 gram

- Permenkes RI No. 30/2013 tentang informasi kandungan GGL dan pesan kesehatan untuk **pangan olahan** dan **pangan siap saji.**
- Bagaimana data konsumsi pangan olahan dan pangan siap saji serta kontribusinya terhadap asupan lemak?

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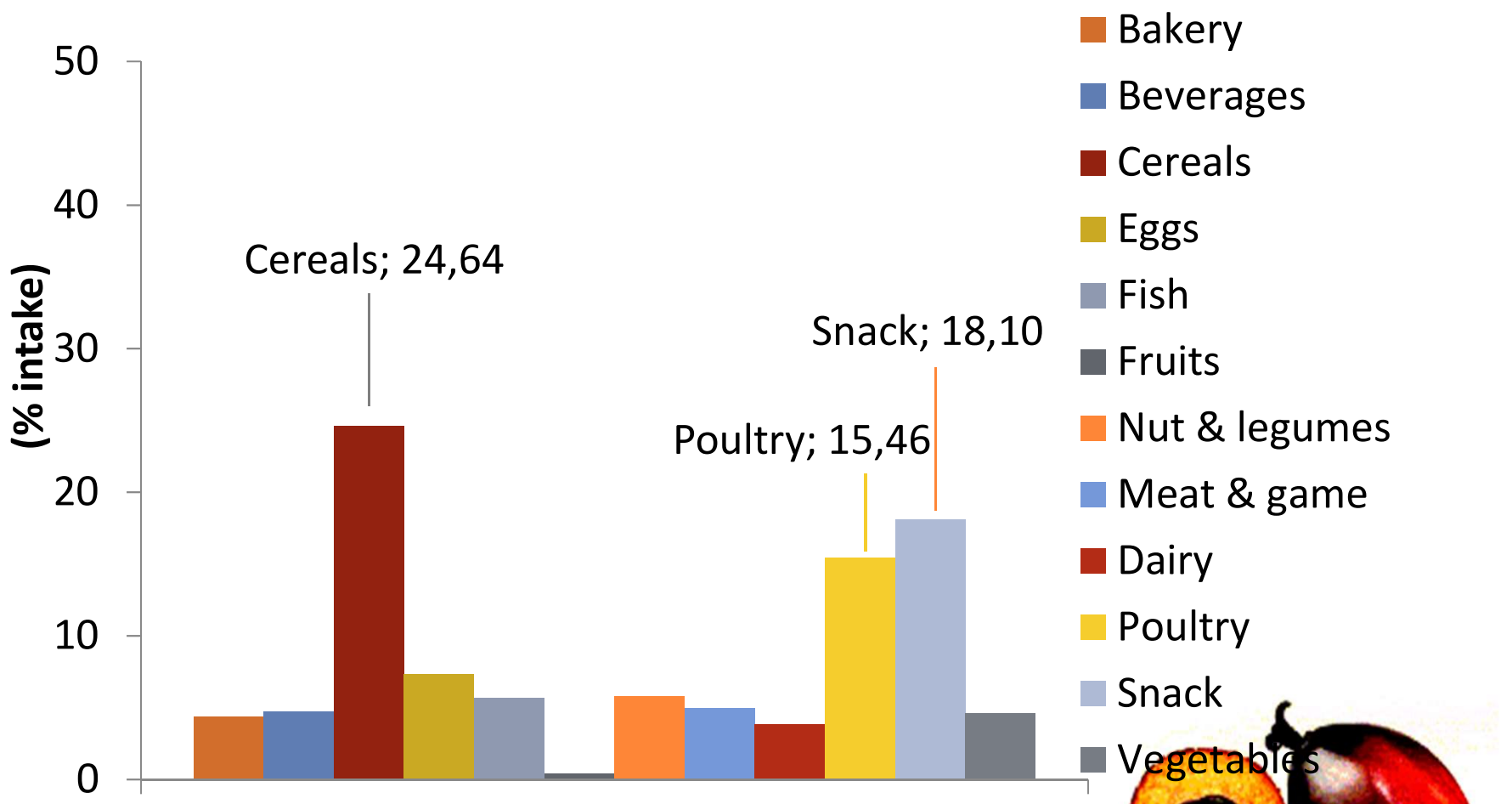
Asupan Lemak

Intake (g/cap/ day)	Adult	Adoles-cent	Child ren	Average	WHO & AHA (2014)	Permen kes 30/2013
Male	56.56	65.46	62.31	61.44	30-35% energy = 56 g (for 2000 kkal)	< 67
Female	49.15	57.61	55.84	54.20		

Andarwulan et al. 2016

Kontribusi Jenis Pangan terhadap Asupan Lemak



Andarwulan et al. 2016

Asupan lemak VS rekomendasi (WHO and USDA)

Consumption	Recommendation	2000 kcal diet	Study result (2016)
Total fat	20-35% energi	45 - 78 g/day	45,47 g/day
Saturated fatty acids	< 10% energi	22 g/day	18,02 g/day
Mono unsaturated fatty acids (MUFA)	*By difference* (15-20% energi)	33 – 45 g/day	16,86 g/day
Poly unsaturated fatty acids (PUFA)	6-11% energi	13 – 25 g/day	5,75 g/day
Trans fatty acids	< 1% energi	< 2 g/day	0,01 g/day
Cholesterol		< 300 mg/day	256,52 mg/day

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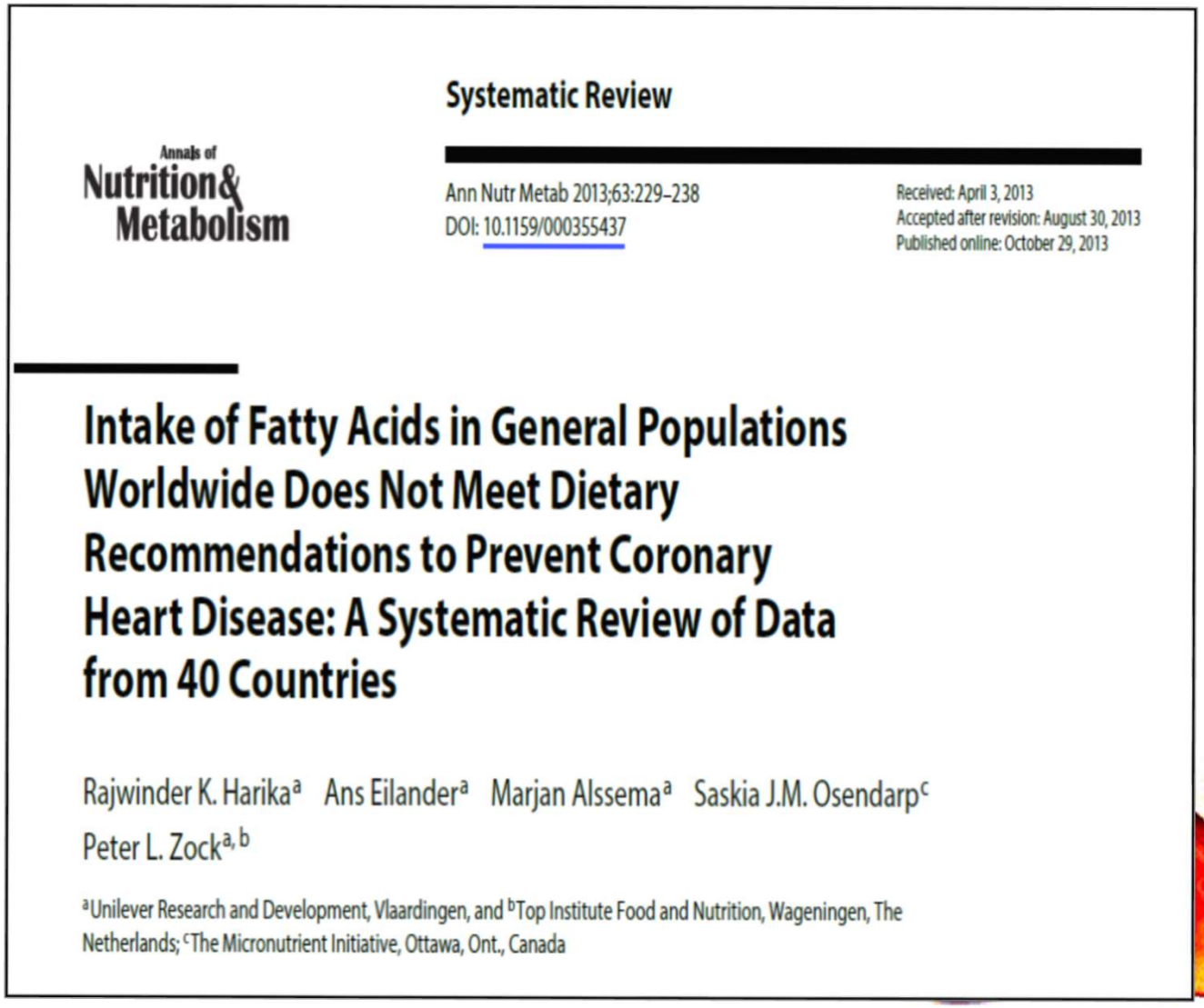
Hasil Kajian **vs** pola asupan lemak di beberapa negara (Harika *et al.* 2013)



Systematic Review

Annals of Nutrition & Metabolism

Ann Nutr Metab 2013;63:229–238
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Intake of Fatty Acids in General Populations Worldwide Does Not Meet Dietary Recommendations to Prevent Coronary Heart Disease: A Systematic Review of Data from 40 Countries

Rajwinder K. Harika[a] Ans Eilander[a] Marjan Alssema[a] Saskia J.M. Osendarp[c]
Peter L. Zock[a, b]

[a]Unilever Research and Development, Vlaardingen, and [b]Top Institute Food and Nutrition, Wageningen, The Netherlands; [c]The Micronutrient Initiative, Ottawa, Ont., Canada

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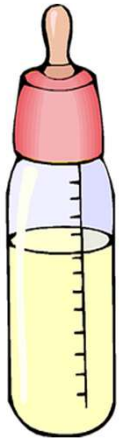
Study result **vs** fat intake pattern in several countries (Harika *et al.* 2013)

Country	Year	Data source	N Sample	Method	fat (g/day)	SF (g/day)	MUFA (g/day)	PUFA (g/day)
Indonesia	2005	cross-sectional	1430	24 h recall	50,41	**33,03**	**8,22**	**5,53**
Malaysia	2011	cross-sectional	151	3 D record	66,50	20,48	**17,23**	**10,75**
USA	2010	NHANES (2007–2008)	5420	2x24 h recall	**80,29**	**25,98**	**29,52**	16,53
China	2003	INTERMAP (cross-sectional)	839	4x24 h recall	45,53	11,38	**18,44**	13,20
India	2006	cross-sectional	102	Ffq	65,07	20,82	**25,16**	19,09
Singapura	2004	national nutrition survey	1278	24 h recall	73,72	22,89	**25,28**	18,36
Korea Selatan	2004	dietary intake study	224	3 D record	55,91	17,36	**19,18**	13,93
Indonesia (Study result)	2016	cross-sectional	323	2 D food record and food weighing	45,47	18,02	**16,86**	**5,75**

Lemak pada ASI dan Susu Formula

Lemak pada ASI menyumbang 45 – 50% energi bayi[2]

Sumber lemak susu formula dapat berasal dari bahan baku susu sapi atau hewan lain dan dari tumbuh-tumbuhan[1]



Susu formula mengandung **campuran spesifik lemak nabati** untuk meniru kandungan asam lemak jenuh (SFA), asam lemak tak jenuh rantai tunggal (MFA), dan asam lemak tak jenuh rantai jamak (PUFA) pada ASI[3]

Campuran minyak nabati yang biasa ditambahkan adalah **minyak olein sawit**, **kelapa**, **kedelai**, **bunga matahari tinggi oleat**, jagung, kanola, safflower, zaitun, dan MCT[4,5,6,7,8,9]

[1]BPOM 2015, [2]Maduko *et al.* 2007, [3]Hashem dan El-Waseif 2016, [4]Baltrope dan Oppe 1973, [5]Nelson *et al.* 1998, [6]Pina-Rodriguez dan Akoh 2010, [7]Innis 2011, [8]Rezhak *et al.* 2011, [9]MDelplanque *et al.* 2015

Pengaruh Distribusi Asam Lemak pada TAG terhadap Penyerapan Lemak dan Kalsium

Sn-1	Oleat		Sn-1	**Palmitat**	
Sn-2	**Palmitat**	**VS**	**Sn-2**	Oleat	
Sn-3	Oleat		Sn-3	**Palmitat**	

SFA dapat disediakan dari minyak kelapa atau *medium chain trigliseride* (MCT) dan lebih mudah dicerna oleh bayi[7, 11]

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[5]Nelson *et al.* 1998, [7]Innis 2011, [10]Lopez-Lopez *et al.* 2001, [11]Rodriguez *et al.* 2003

Komposisi asam lemak ASI

Fatty acids	*Mean*[a] *(n=40)*	*s.d.*[b]	*range*
C8:0	0.22	±0.04	0.15–0.35
C10:0	1.63	±0.56	1.02–3.21
C12:0	5.27	±1.94	2.94–12.43
C14:0	5.76	±1.19	4.1–8.86
C14:1	0.44	±0.13	0.21–0.75
C15:0	0.38	±0.08	0.22–0.57
C16:0	21.36	±1.68	18.31–24.35
C16:1	2.39	±0.39	1.79–3.20
C17:0	0.39	±0.05	0.27–0.49
C17:1	0.30	±0.05	0.21–0.40
C18:0	6.92	±1.00	4.92–8.63
C18:1	38.57	±4.81	25.7–44.17
C18:2 n6	13.34	±3.41	7.67–21.29
C18:3 n6	0.12	±0.02	0.07–0.16
C20:0	0.20	±0.03	0.13–0.26
C18:3 n3	0.69	±0.18	0.46–1.14
C20:1 n9	0.61	±0.11	0.36–0.80
C20:2 n6	0.29	±0.09	0.16–0.48
C20:3 n6	0.35	±0.06	0.24–0.46
C20:4 n6	0.41	±0.07	0.24–0.54
C22:5 n3	0.12	±0.02	0.07–0.15
C22:6 n3	0.27	±0.05	0.15–0.39
SFA	42.13		
MUFA	42.29		
PUFA n-3	1.08		
PUFA n-6	14.50		

Triacylglycerol markers of mature human milk

January 2004 · European Journal of Clinical Nutrition 57(12):1621-6
DOI: 10.1038/sj.ejcn.1601733

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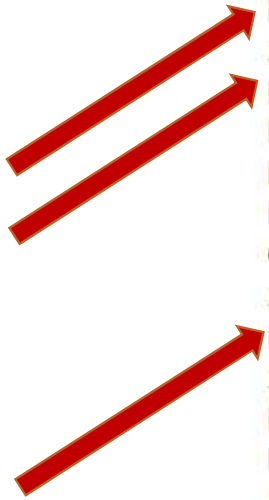
Triacylglycerol (carbon number)	AMF (wt%)	MF-TAG (wt%)
24	0.29 ± 0.00	0.21 ± 0.01
26	0.19 ± 0.01	0.15 ± 0.00
28	0.42 ± 0.02	0.36 ± 0.00
30	1.13 ± 0.07	0.86 ± 0.04
32	2.32 ± 0.00	2.26 ± 0.05
34	5.76 ± 0.07	5.98 ± 0.08
36	12.77 ± 0.16	13.35 ± 0.08
38	14.53 ± 0.10	15.32 ± 0.11
40	11.78 ± 0.14	12.34 ± 0.01
42	8.27 ± 0.03	8.70 ± 0.04
44	7.58 ± 0.00	7.76 ± 0.04
46	8.26 ± 0.03	8.15 ± 0.03
48	9.37 ± 0.08	8.99 ± 0.00
50	9.65 ± 0.13	8.54 ± 0.00
52	7.91 ± 0.37	6.69 ± 0.00

[a]Average of two replicates and standard deviation. For abbreviations see Table 2 and 3.

Table 3 Composition (w/w) TAGs in mature human milk

TAG molecular species[a]	*MW*	*mean*[b]	*s.d.*[c]	*Range*
LaLaM/LLL	666.7	0.64	±0.23	0.91–0.34
PLaCa/LaCaO	692.7	0.26	±0.11	0.50–0.11
LaOL/MPLn	800.7	0.94	±0.44	1.99–0.37
LaMP/LaLaS	722.6	0.36	±0.11	0.54–0.18
LaMO/CaPO	748.7	0.57	±0.23	1.09–0.27
LLO	880.7	1.65	±0.76	3.51–0.52
LaPL	774.7	1.61	±0.89	3.90–0.40
LaOO/MPL	802.7	0.92	±0.24	1.40–0.38
LLP/PLnO/LPaO	854.7	1.57	±0.59	3.61–1.28
LaOP/MMO	776.7	2.33	±0.25	3.33–0.35
LaPP/LaMS	750.7	0.79	±0.59	3.23–1.09
MOL	828.7	2.63	±0.25	1.43–0.35
MOO/PPL/PaOP	830.7	3.23	±1.22	5.38–1.42
LOO	882.8	5.01	±1.84	10.18–1.64
SPLa	778.7	2.26	±0.52	3.19–1.20
POL	856.8	16.65	±5.45	38.15–9.24
PaLS	856.8	5.04	±1.64	8.33–1.84
PaOO	856.8	1.70	±0.68	3.39–0.66
MPO	804.7	3.12	±1.06	5.14–1.12
OOO	884.8	5.26	±2.88	11.96–1.61
SLO	884.8	2.03	±0.73	3.11–1.02
POO	858.8	27.24	±6.67	42.44–17.56
SPL	858.8	2.51	±1.66	7.71–0.98
PPO/MOS	832.8	5.13	±1.73	8.49–2.15
MPS	806.7	0.39	±0.22	0.91–0.14
SOO	886.8	1.22	±0.38	1.95–0.91
SOP	860.8	4.54	±1.34	7.46–2.09
SPP	834.8	0.25	±0.15	0.57–0.07
SOS	888.8	0.06	±0.02	0.09–0.02
SSP	862.8	0.06	±0.02	0.09–0.02



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Komposisi Triasilgliserol (TAG) Minyak Sawit, AMF, ASI

TAG*	ECN**	Jenis minyak/lemak		
		PO	AMF	Human Milk
CaCaLa	32	-	2.32	
CaLaLa	34	-	5.76	
LaLaLa	36	-	12.77	
LaLaM	38	-	14.53	0.64
LaLaO	40	-	11.78	
LaMM	40	-		
LLLn	40	-		
LLL	42	-	8.27	
OLLn	42	-		
PLLn	42	-		
OLL	44	0.80		1.65
OLPo	44	-		
PLL	44	3.00	7.58	1.57
OLnO	44	-		
OLO	46	2.10		5.01
PLO	46	11.80	8.28	16.65
PLP	46	11.00		
OOO	48	4.30		5.26
POO	48	25.40	9.37	27.24
POP	48	30.60		5.13
PPP	48	0.80		
SOO	50	2.80		
POS	50	5.60	9.65	4.54
PPS	50	0.10		
SSO	52	0.5	7.91	

Komposisi Triasilgliserol (TAG) Minyak Nabati

TAG*	ECN**	Jenis minyak nabati**				
		PO	HOSO	CNO	SBO	CaO
CaCaLa	32	-	-	12.90	-	-
CaLaLa	34	-	-	17.4	-	-
LaLaLa	36	-	-	21.20	-	-
LaLaM	38	-	-	18.00	-	-
LaLaO	40	-	-	3.10	-	-
LaMM	40	-	-	10.20	-	-
LLLn	40	-	-	-	-	-
LLL	42	-	-	-	32.00	5.83
OLLn	42	-	-	-	-	-
PLLn	42	-	-	-	-	-
OLL	44	0.80	0.70	-	30.50	10.61
OLPo	44	-	-	-	-	-
PLL	44	3.00	-	-	8.00	-
OLnO	44	-	-	-	-	-
OLO	46	2.10	1.30	-	9.80	21.74
PLO	46	11.80	-	-	9.50	7.40
PLP	46	11.00	-	-	1.00	-
OOO	48	4.30	91.30	-	3.00	31.85
POO	48	25.40	4.40	-	3.80	-
POP	48	30.60	-	-	0.50	-
PPP	48	0.80	-	-	1.00	-
SOO	50	2.80	2.30	-	0.50	2.70
POS	50	5.60	-	-	0.20	-
PPS	50	0.10	-	-	0.20	-
SSO	52	0.5	-	-	-	-

Sumber: Tan dan Man 2002, Li *et al.* 2010, Clereq et al. 2012, Fauzi *et al.* 2013, dan Alvarez dan Akoh 2016

Minyak Sawit sebagai Ingredien Infant Formula

KOMPOSISI

Protein whey, Campuran minyak nabati (mengandung antioksidan dl alpha tokoferol dan askorbil palmitat), Maltodekstrin, Susu bubuk skim, Laktosa, FOS-Inulin, Premiks mineral, Pengemulsi lesitin kedelai, 13 Vitamin, DHA (mengandung antioksidan tokoferol), AA (mengandung antioksidan tokoferol dan askorbil palmitat), Kolin klorida

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PLOS ONE

RESEARCH ARTICLE

Lipid profile of different infant formulas for infants

Marcio Antonio Mendonça[1]*, Wilma Maria Coelho Araújo[2], Luiz Antonio Borgo[1], Ernandes de Rodrigues Alencar[1]

1 Faculty of Agronomy and Veterinary Medicine, University of Brasilia, Brasilia, Brazil, 2 Department of Nutrition, College of Health Sciences, University of Brasilia, Brasilia, Brazil

PLOS ONE | https://doi.org/10.1371/journal.pone.0177812 June 1, 2017

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Table 2. Information stated on the labeling of segment infant formula and infant formulas for breastfeeding aimed at needs specific dietary analyzed.

Classification	Product	Source lipidic *	g/100mL	g/100kcal
Segment infant formula	SIF	Lipid Profile: 98 g/100g of vegetable fat (palm olein, palm kernel oil, canola oil, corn oil, soy lecithin); 2 g/100g milk fat; It provides the recommended levels of linoleic and α-linolenic acids.	Lipids—3.10 C18:2–0.50 C18:3–0.06 ω3:ω6–7.7	Lipids– 4.60 C18:2–0.70 C18:3–0.09 ω3:ω6
Infant formulas for breastfeeding aimed at needs specific dietary	IFSACMPM	Lipid profile: LCPUFAs (DHA and ARA, 1.1); medium chain triglycerides.	Lipids– 3.45 Saturated FA– 1.10 Monounsaturated FA–1.70 Polyunsaturated FA–0.70 C18:2–0.600 C18:3–0.060 ω3:ω6–10	Lipids– 3.83 Saturated FA * Monounsaturated FA* Polyunsaturated FA* C18:2* C18:3* ω3:ω6–10
	LFIF	Lipid Profile: 98 g/100g vegetable fat (palm olein, canola oil, coconut oil, sunflower oil, soy lecithin, docosahexaenoic acid, arachidonic acid); 2 g/100g milk fat. Soya lecithin addition, docahexanoico acid, arachidonic acid.	Lipids– 3.30 C18:2–0.50 C18:3–0.067 ω3:ω6–8.00	Lipids– 5.00 C18:2–0.80 C18:3–0.099 ω3:ω6–8.00
	SPIIF	Lipid Profile: 100 g/100g vegetable fat (palm olein, soy oil, coconut oil, sunflower oil); It provides the recommended levels of linoleic and α-linolenic acids.	Lipids– 3.40 C18:2–0.60 C18:3–0.066 ω3:ω6–9.2	Lipids– 5.40 C18:2–0.90 C18:3–0.098 ω3:ω6–9.2
	WPEHIF	Lipid profile: 50 g/100g medium-chain triglycerides; 49% vegetable oils (rapeseed, sunflower, palm); 1% fish oil and Mortierella alpina oil; adding ARA (0.2 g/100g) and DHA (0.2 g/100g) of total lipids.	Lipids– 3.50 Arachidonic acid–0.0067 Docosahexaenoic acid– 0.0067 C18:2–0.48 C18:3–0.09 ω3:ω6–5.4	Lipids– 5.30 Arachidonic acid–0.010 Docosahexaenoic acid– 0.010 C18:2–0.72 C18:3–0.13 ω3:ω6–5.4
	WPPHIF	Lipid Profile: 97 g/100g of vegetable fat (palm olein, coconut oil, sunflower oil, fish oil—a source of DHA, vegetable oil from Mortierella alpina—ARA source); 3 g/100g milk fat; It provides the recommended levels of linoleic and α-linolenic acids. Adding arachidonic fatty acid.	Lipids– 3.40 C18:2–0.50 C18:3–0.052 ω3:ω6–9.50	Lipids– 5.10 C18:2–0.70 C18:3–0.078 ω3:ω6–9.50

* Withdrawal of the information provided by the manufacturer

SIF—Segment Infant Formula; IFSACMPM—Elementary Infant Formula for Severe Allergy to Cow's Milk Proteins and Multiple Foods; LFIF—Lactose-Free Infant Formula; SPIIF—Soy Protein Isolate-based Infant Formula; WPEHIF—Whey Protein Extensively Hydrolyzed Infant Formula; WPPHIF—Whey Protein Partially Hydrolyzed Infant Formula.

3. Minyak Sawit & Risikonya

Persepsi terhadap SFA (Asam Lemak Jenuh)

2012 *World Health Organization* state that:

- Increased risks of **Cardiovascular diseases (CVD)** was associated with increased blood cholesterols levels,
- and high consumption of **saturated fatty acids (SFA)**
- What about the consumption of Palm Oil as vegetable oils?
- What is the current clinical or population data on this matter?

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Meta analysis of Palm Oil Consumption

- Consumption of Palm Oil results in favorable changes compared to other SFAs, MUFAs, dan PUFAs.
- There was no significant effect on TC/HDL cholesterol LDL cholesterol/HDL cholesterol ratios - non apparent effect on CVD risks
- It was apparent that increase of cholesterol was more affected by age and *trans fatty acids.*

Fattore et al, *Am J Clin* (2014)

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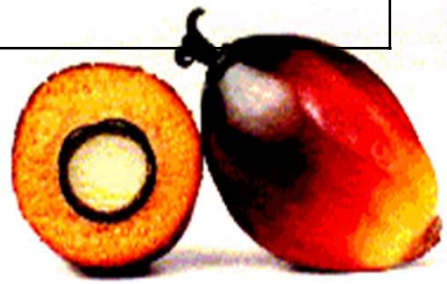
Palm Oil and risks of T2DM

Year	Authors	Subjects (clinical)	Study type	Results
2014	Filippou et al.	53 adult male and female (age 20-50). South East Asia subjects	*Case control*	*Palmitic acids do not affect the secretion of insulin (which is altered and problematic in T2DM) and glucose homeostasis in healthy male and female subjects. This indicate that consumption of palm oil does not lead to T2DM.*
2014	Filippou et al.	25 healthy adult male and 25 female, Euro subjects	*Case control*	*The authors found that palmitic acids do not affect insulin secretion and blood levels in healthy subjects.*



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Palm Oil and risks of T2DM

Year	Authors	Subjects (clinical)	Study type	Results
2009	Bovet et al.	1255 subjects *Seychelles*	*Cross-sectional study* dengan interview survey	*The large population study conducted here involved 15 years of reduction in palm oil consumption, replacing it with animal origin fat, which resulted in the increase of T2DM (30% in female, 50% in male). The population of Seychelles was observed in the study.*
2011	Peairs et al.	11 obese subjects (BMI >27)	*Experimental acute feeding*	*Saturated fatty acids from palm oil decrease the secretion of insulin after meals, but do not increase blood glucose levels. This may indicate the opposite to the onset of T2DM.*

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Summary

- Chemical properties of palm oil is unique and different as compare to other vegetable oils.
- Palm oil has a high versatility as food ingredients.
- Total fat average intake of Indonesia population were below maximum recommendation. However, intake of fatty acids does not meet the dietary recommendation.
- Consumption of palm oil was not observed to change cholesterol and risks to CVD.
- Chronic consumption of palm oil does not increase risk of diabetes mellitus type 2.

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Thank you

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andarwulan@apps.ipb.ac.id