

# Palm Oil: Opportunities and Challenges in Regulatory Framework

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## ABSTRACT

Nutritional policies and public perceptions of palm oil have long been shaped by its classification as a predominantly saturated fat, a designation increasingly challenged by recent evidence. This study examines the dynamic changes in fatty acid composition of palm oil derived from the Deli Avros cultivar (*Elaeis guineensis*) during fruit ripening, alongside a broader reassessment of palm oil's nutritional profile and regulatory treatment. Longitudinal analysis conducted between 12 and 24 weeks post-anthesis demonstrates a progressive increase in monounsaturated fatty acids, primarily oleic acid, a concomitant decrease in polyunsaturated fatty acids, mainly linoleic acid, and a relatively stable saturated fatty acid content dominated by palmitic acid. Crucially, saturated fatty acid content dominated by palmitic acid remains relatively stable, contradicting the prevailing view that palm oil is excessively saturated.

Compositional analysis confirms that palm oil comprises approximately equal proportions of saturated and unsaturated fatty acids, positioning it closer to nutritionally favourable oils than commonly perceived. This biochemical evidence is discussed in the context of recent systematic reviews indicating no clear cardiovascular or mortality benefit from population-wide reductions in saturated fat intake, as well as ongoing reassessments by the 2025 Dietary Guidelines Advisory Committee and the World Health Organization. Beyond fatty acids, the

review highlights the significance of palm oil's minor constituents, including tocotrienols, carotenoids, squalene, and phytosterols, which contribute to oxidative stability and exhibit documented bioactive potential. Advances in lipidomics further underscore the complexity of palm oil's lipid matrix and the limitations of conventional nutrient-based classifications. Collectively, these findings support an evidence-based reframing of palm oil within nutritional science and public health policy, emphasizing compositional integrity, food matrix effects, and regulatory transparency over legacy branding and oversimplified saturated fat labels.

## 1.0 DYNAMIC CHANGES IN FATTY ACID COMPOSITION AND NUTRITIONAL PROFILE

Longitudinal analysis of palm oil from the Deli Avros cultivar of *Elaeis guineensis* reveals significant shifts in fatty acid composition between 12 and 24 weeks post-anthesis (**Figure 1**) (1). Specifically, monounsaturated fatty acids (MUFA), primarily oleic acid, exhibit a progressive increase throughout maturation, suggesting an enhancement in nutritional quality. In contrast, polyunsaturated fatty acids (PUFA), mainly linoleic acid, decrease steadily, indicating reduced susceptibility to oxidative degradation and improved shelf stability. Saturated fatty acids (SFA), predominantly palmitic acid,

## Dynamic Changes in fatty acid Composition

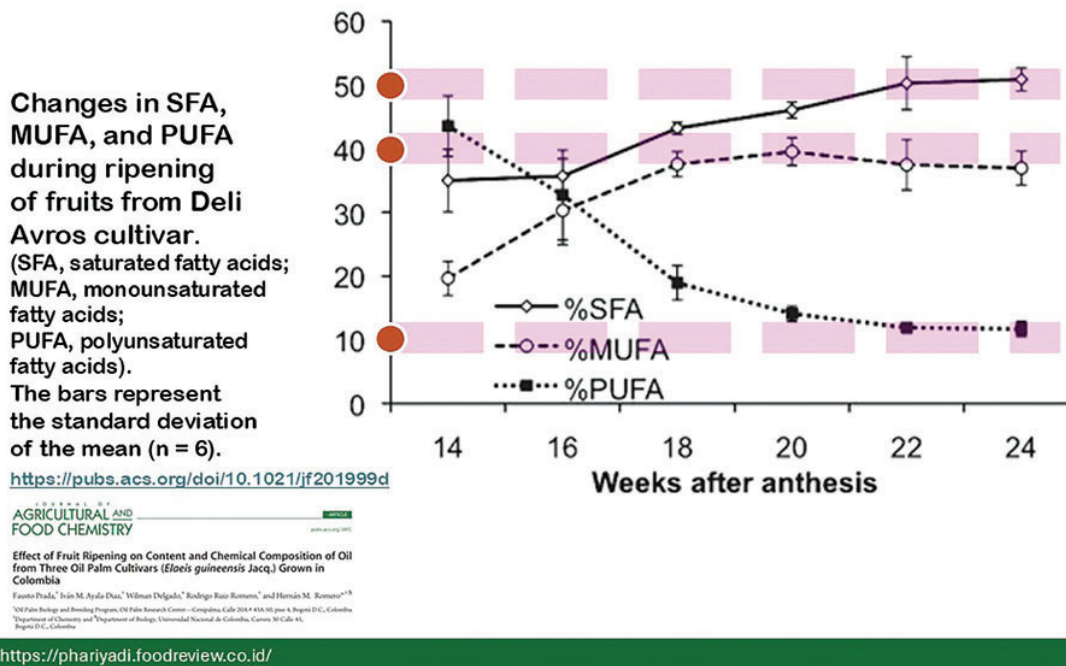


Figure 1: Fatty acid composition of palm oil during fruit ripening: Reevaluating nutritional safety

remain relatively constant over the developmental period, challenging the perception that palm oil is excessively saturated. Measurements were performed in six replicates ( $n = 6$ ), with error bars representing the standard deviation, confirming the reproducibility of the data. These results highlight the dynamic regulation of fatty acid biosynthesis during fruit ripening and underscore the importance of considering cultivar-specific and developmental-stage-specific profiles when evaluating palm oil's nutritional attributes and implications for dietary recommendations.

Palm oil exhibits a more balanced fatty acid composition than commonly perceived, challenging its frequent classification as predominantly saturated (Figure 2). Analysis indicates that saturated and unsaturated fatty acids are present in roughly equal proportions:

### Saturated Fatty Acids (~50%)

- Palmitic acid (C16:0): 44%
- Stearic acid (C18:0): 5%
- Trace amounts of myristic acid (C14:0)

### Unsaturated Fatty Acids (~50%)

- Oleic acid (C18:1, monounsaturated): 40%
- Linoleic acid (C18:2) and  $\alpha$ -linolenic acid (C18:3, polyunsaturated): ~10%

When compared quantitatively with other commonly consumed vegetable oils, palm oil's fatty acid profile shows meaningful overlap rather than categorical divergence. Olive oil typically contains ~70–75% oleic acid with ~14% SFA, canola oil contains ~60–65% MUFA with ~7% SFA, while soybean oil contains ~50–55% PUFA with ~15% SFA. In contrast, palm oil occupies an intermediate position, characterised by moderate SFA content combined with substantial MUFA levels and lower PUFA, conferring greater oxidative stability during cooking.

This compositional profile highlights that palm oil cannot be categorically classified as saturated fat. Rather than warranting simplistic labeling, palm oil composition supports a reclassification framework based on fatty acid balance, thermal stability, and dietary context. The substantial presence of monounsaturated and polyunsaturated fatty acids,

## Nutritional profile of fatty acid

In general:

Fatty Acid profile of Palm oil:

• Approximately 50% saturated FAs:

- 44% palmitic acid (C16:0)
- 5% stearic acid (C18:0), and
- trace amounts of myristic acid (C14:0).

'saturated oil' is a miscategorization of palm oil.

• Approximately 50% unsaturated FAs:

- 40% oleic acid (C18:1), monounsaturated FA
- 10% polyunsaturated linoleic acid (C18:2) and linolenic acid (C18:3)

?  
Why not even considering that palm oil is "unsaturated oil"?

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Figure 2: Reassessing palm oil: Balanced fatty acid composition challenges saturated fat labeling

particularly oleic acid, positions palm oil closer to nutritionally favorable oils, such as olive oil, in terms of lipid diversity. These findings highlight the importance of evaluating palm oil based on its actual fatty acid spectrum rather than solely its botanical origin or industrial perception. Such evidence-based reassessment is critical for informed dietary recommendations and public health messaging, particularly in regions where palm oil is a primary cooking fat.

## 2.0 PALM OIL IS UNFAIRLY LABELED AS SATURATED OIL

Astrup et al. reported on a review (Figure 3) that there is no clear cardiovascular or mortality benefit from reducing saturated fatty acid (SFA) intake and suggested potential protection against stroke (2). Although SFAs raise LDL cholesterol, this primarily involves larger, less atherogenic particles, and the effects of SFAs are further influenced by the food matrix and overall diet composition. Foods high in

SFAs, such as whole-fat dairy, unprocessed meat, and dark chocolate, are not associated with increased cardiovascular disease or diabetes risk.

Meta-analyses analysed prospective cohort studies and found no significant association between saturated fatty acid (SFA) intake and all-cause mortality (RR 0.99, 95% CI 0.91-1.09), CVD mortality (RR 0.97, 0.84-1.12), or total CHD (RR 1.06, 0.95-1.17) (3). This aligns with Astrup et al., in which the review concluded that current population-wide limits on SFA intake, including the U.S. guideline of <10% of calories, are not strongly supported by evidence and should be reconsidered in the context of whole foods rather than individual nutrients.

Processing effects are also relevant when evaluating palm oil's nutritional quality. While excessive refining and repeated high-temperature reuse may reduce minor bioactives and promote oxidation, properly refined palm oil retains functional stability and remains comparable to other commonly used cooking oils under typical household and industrial conditions (4).

**Palm oil is unfairly labeled as a saturated oil.**

**Continue debate:**

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**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

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**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 also apparent that the health effects of foods cannot be predicted by their content in any nutrient group without considering the overall macronutrient distribution. Whole-fat dairy, unprocessed meat, and dark chocolate are SFA-rich foods with a complex matrix that are not associated with increased risk of CVD. The totality of available evidence does not support further limiting the intake of such foods. (J Am Coll Cardiol 2020;76:844-57) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

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**Figure 3:** Review paper deliberated on there is no clear cardiovascular or mortality benefit from reducing saturated fatty acid

**Palm oil is unfairly labeled as a saturated oil.**

The screenshot shows the website [dietaryguidelines.gov/scientific-questions](https://dietaryguidelines.gov/scientific-questions). The main heading is "Work Under Way". Under "Scientific Questions", a search bar highlights the question: "What is the relationship between food sources of saturated fat consumed and risk of cardiovascular disease?".

The USDA and Health and Human Services have requested that the recommendations regarding the "saturated fat" for the 2025-2030 Dietary Guidelines for Americans be reviewed.

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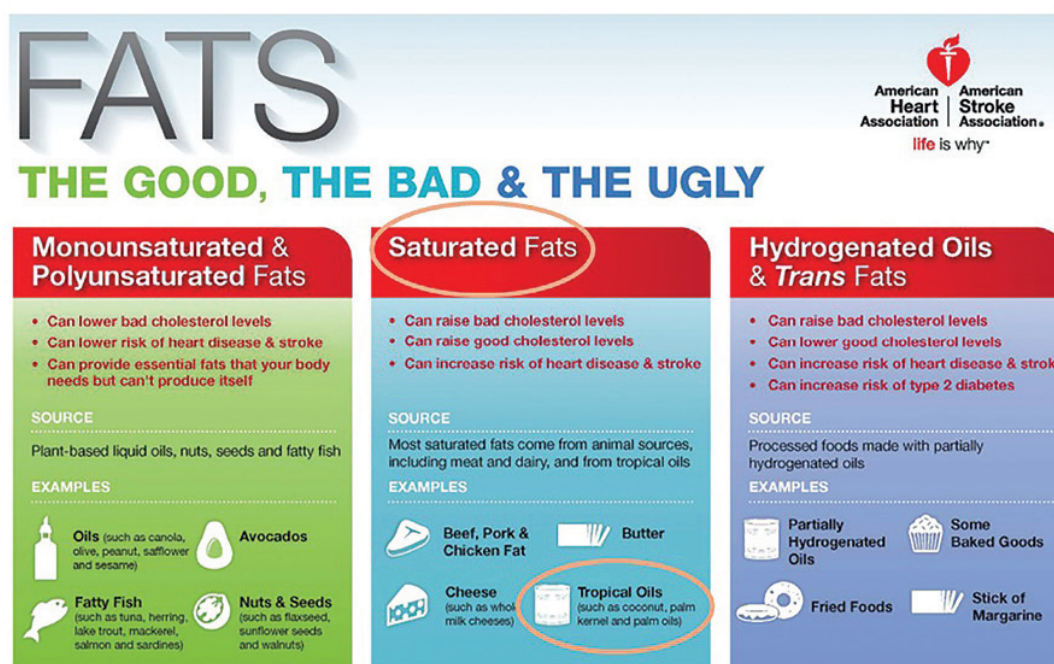
**Figure 4:** Reevaluating saturated fat guidelines: Palm oil and the 2025–2030 dietary recommendations

The 2025 Dietary Guidelines Advisory Committee (DGAC) is actively reevaluating dietary fat recommendations, with particular focus on sources of saturated fat such as palm oil (**Figure 4**). The U.S. Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA) are conducting systematic reviews to examine the relationship between consumption of saturated fat-containing foods and cardiovascular disease risk (3). Palm oil, often labeled as a saturated fat, contains roughly equal proportions of saturated (primarily palmitic acid, C16:0, and stearic acid, C18:0) and unsaturated fatty acids (notably oleic acid, C18:1, and linoleic acid, C18:2), suggesting that its effects on atherogenesis may differ from other saturated fats when consumed in moderation within whole-food dietary patterns. These findings highlight the need to distinguish between sources and types of saturated fats in public health guidance, supporting evidence-based revisions that reflect the biochemical diversity of fats and their context-dependent health impacts,

in alignment with the DGAC's systematic, data-driven approach to the 2025–2030 Dietary Guidelines for Americans.

Parallel to nutritional reassessment, regulatory measures such as the European Union Deforestation Regulation (EUDR) introduce new sustainability-linked compliance requirements for palm oil imports. While environmental objectives are legitimate, the implementation of EUDR without proportionality, flexibility, and adequate technical support risks functioning as a de facto trade barrier. This is particularly relevant for smallholders and producing countries, where compliance costs, traceability infrastructure, and verification capacity may be unevenly distributed. Without appropriate transition mechanisms, such regulations may unintentionally penalise sustainable producers and disrupt inclusive supply chains rather than incentivising genuine environmental improvement.

## Nutritional framing ?



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**Figure 5:** Palm oil is often branded as tropical fat and unfairly given negative connotation

### 3.0 REFRAMING THE NUTRITIONAL DISCOURSE ON PALM OIL AND TROPICAL FATS

Although palm oil is commonly categorised as a saturated fat, its composition is approximately balanced between saturated fatty acids—primarily palmitic acid—and unsaturated fatty acids, notably oleic and linoleic acids. This profile indicates that labeling palm oil solely as a “saturated oil” is overly simplistic and potentially misleading. Palm oil is also frequently described as a “tropical fat,” a term carrying implicit negative connotations in public health discourse (Figure 5). This branding reflects not only biochemical characteristics but also geographic origin, cultural context, and historical biases, and has often been used to associate tropical oils with adverse health outcomes despite their nuanced lipid profile.

Historical analyses, including those referenced by the International Coconut Forum, showed that late

20th-century vegetable oil industry campaigns actively promoted the narrative that tropical oils—including palm and coconut—were unhealthy, shaping regulatory decisions and consumer perceptions in ways not always supported by rigorous scientific evidence. In response to ongoing debate, the World Health Organization (WHO) issued a call in October 2023 for expert input to develop guidelines on tropical oil consumption, reflecting the need to reassess dietary fat recommendations based on contemporary evidence and global perspectives (4). Subsequently, two WHO-commissioned rapid reviews evaluated the effects of palm and coconut oil relative to other vegetable oils on mortality and cardiovascular outcomes in both children and adults, signaling a move toward evidence-based neutrality in dietary fat assessment. The first meeting of the WHO Expert Group, held in May 2024, emphasised the importance of panel representativeness and a balanced, scientifically rigorous approach.

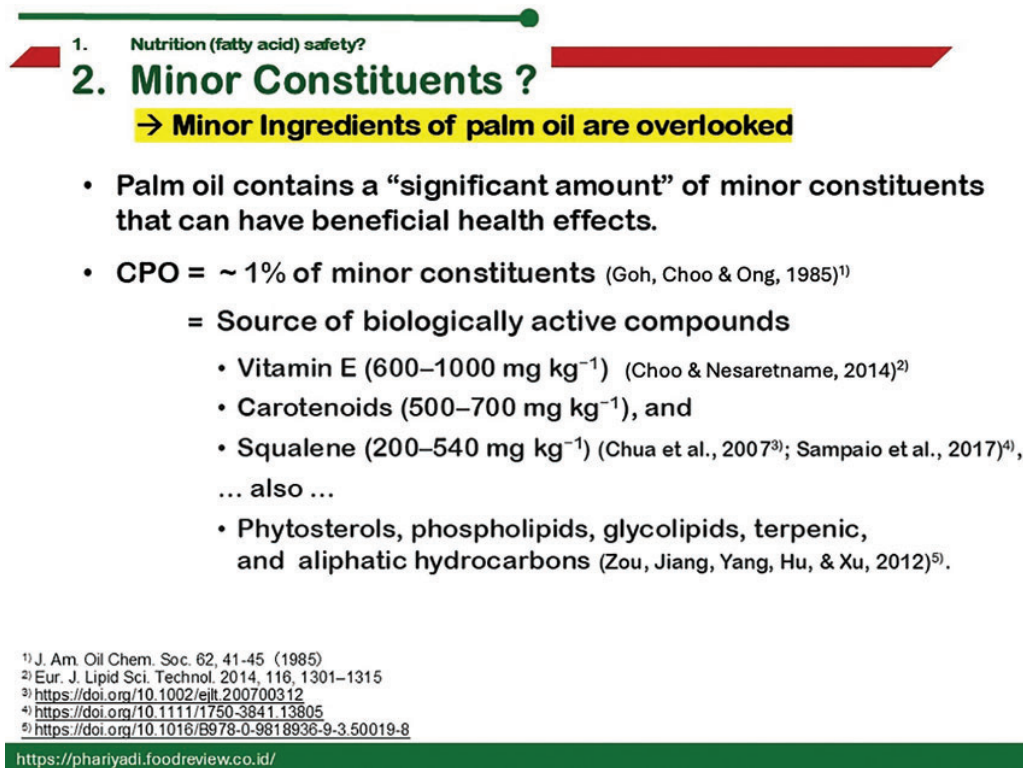


Figure 6: Minor constituents in palm oil

#### 4.0 MINOR CONSTITUENTS OF PALM OIL AND THEIR BIOACTIVE POTENTIAL

Although palm oil is often assessed primarily based on its fatty acid composition, increasing evidence underscores the importance of its minor constituents, which comprise roughly 1% by weight in crude palm oil (CPO). These bioactive compounds contribute not only to the oxidative stability and sensory quality of the oil but also to its potential health-promoting properties. Crude palm oil contains a diverse array of these constituents, including vitamin E (600–1000 mg/kg), which encompasses both tocopherols and tocotrienols, with tocotrienols being particularly abundant and exhibiting superior antioxidant and neuroprotective effects compared to tocopherols (**Figure 6**). Carotenoids (500–700 mg/kg), primarily  $\alpha$ - and  $\beta$ -carotene, serve as precursors to vitamin A and act as potent antioxidants, while squalene (200–540 mg/kg), a triterpenoid involved in cholesterol biosynthesis, confers antioxidative and skin-protective effects.

Other minor constituents, such as phytosterols, phospholipids, glycolipids, and various terpenic and aliphatic hydrocarbons, support membrane integrity, exert cholesterol-lowering effects, and exhibit anti-inflammatory activity. Functionally, these bioactive compounds have been associated with a broad spectrum of biological activities, including antioxidation through the neutralisation of reactive oxygen species and protection against lipid peroxidation; modulation of cell signaling and inhibition of tumor growth in preclinical cancer models; downregulation of pro-inflammatory cytokines and eicosanoid synthesis; improvement of lipid profiles and attenuation of vascular inflammation; and modulation of intestinal absorption and hepatic metabolism to reduce cholesterol levels.

Regulatory recognition of these effects has emerged in Malaysia, where the Ministry of Health has authorised food nutrient function claims for the palm tocotrienol-rich fraction (Palm TRF), citing its potential to support cognitive function and mitigate oxidative stress (5). To qualify for these claims, fortified products must contain at least 10 mg of pure tocotrienols per 100 g of solid or 100 mL of liquid finished product, reflecting the translation of bioactive evidence into practical, regulated applications.

#### 5.0 EMERGING INSIGHTS FROM LIPIDOMICS

Advances in analytical methodologies, particularly lipidomics, now enable comprehensive characterisation of complex lipid species beyond conventional fatty acid profiling. These approaches offer new opportunities to elucidate the functional and metabolic roles of palm oil constituents (5), including minor bioactive compounds that are frequently overlooked in regulatory assessments. Concurrently, growing scientific and industrial efforts to replicate palm oil functionality through alternative technologies underscore its unique nutritional and economic value.

#### 6.0 CONCLUSION: REGULATORY REASSESSMENT AND SCIENTIFIC INTEGRITY IN PALM OIL DISCOURSE

Palm oil continues to face significant challenges within global regulatory frameworks, largely due to persistent mislabeling and legacy biases. Despite its balanced fatty acid composition: approximately 50% saturated and 50% unsaturated, palm oil is frequently and unfairly categorised as saturated fat, a classification that oversimplifies its nutritional profile and overlooks its potential health benefits.

Historical marketing campaigns, particularly those driven by the vegetable oil industry in the late 20th century, successfully branded tropical oils as unhealthy, contributing to widespread public and institutional misconceptions. This narrative has shaped dietary guidelines and consumer behavior, often without adequate scientific justification.

Recent developments, including systematic reviews commissioned by the World Health Organization and the formation of an expert guideline development group, signal a critical opportunity to re-evaluate palm oil through a contemporary scientific lens.

These efforts underscore the need for:

- Evidence-based reassessment of saturated fat classifications.
- Inclusion of minor bioactive constituents in nutritional evaluations.
- Application of lipidomics to capture the complexity of palm oil's biochemical profile.

- Regulatory transparency and public education to counter misinformation and support informed dietary choices.

Moving forward, it is essential that regulatory frameworks reflect current science and consider the broader dietary context. A balanced, interdisciplinary perspective is vital to ensure that palm oil is evaluated not by its origin or historical branding, but by its actual physiological impact and compositional integrity.

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