Food safety & nutrition issues: challenges and opportunities for Indonesian palm oil

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Abstract. About 85% of palm oil, the most traded vegetable oil in the world, is used for food applications. Especially with increasing consumer awareness about the relationship between food, safety and health, the issue of food and nutrition safety is always become a major concern in the palm oil industry. The palm oil industry, in meeting the needs of the food industry throughout the world, must comply with food and nutrition safety standards, such as codex standards. In this presentation, some challenges related to food safety and nutrition will be discussed; including (i) the safety of compounds formed during the refining process, such as glycidol and chloropropanediol and (ii) safety aspects related to the fatty acids composition of palm oil. Finally, this presentation will also discuss opportunities for palm oil, not only opportunities to overcome the challenges of safety issues, but also in taking advantage of the potential unique benefits of palm oil, due to the content of its functional components, such as tocopherol, tokoctrienol and carotene.

1. Introduction
Indonesia is blessed with rich soil and perfect climate suitable for optimum growth of oil palm trees. Consequently, oil palm tree can nicely grow and produce oil (namely palm oil) which very important commodity for health of population and economy of Indonesia. In its development, palm oil processing industry is one of the strategic agricultural-based industries in Indonesia economy. Currently, Indonesia is the largest palm oil producing country in the world.

Palm oil tree, as plant producing edible oil, is superior especially associated with its high productivity. Potentially, productivity of palm oil tree may reach about 8 tons oil/hectare /year in most regions, however, current average actual yields are about 3.3 tons/hectare /year [4]. This productivity is much higher as compared to that of soybean oil (only 0.4 tons/hectare) and sunflower seed oil (0.5 tonnes/hectare). Not only that the productivity is high, palm oil also has a longer productive life span (≥25 years). Palm oil also have a cheaper production costs, of about US $160/ton, compared to that of soybean of about US$300/ton [7].
Currently, palm oil is the world’s most traded vegetable oil. Most of the palm oil produced (around 85%) is used for food [5], especially as a cooking oil, and it may be found as ingredient for most margarine, ice cream and many varieties of ready-to-eat meals.

Since safety is a prerequisite of food, then issue of food safety is very relevant and is increasingly become more and more critical for palm oil. As advocated by Food & Agricultural Organization (FAO), “if it is not safe then it is not foods” (http://www.fao.org/fao-stories/article/en/c/1179647/), then palm oil used for food application has to comply with the food safety standard.

According to the 2015 Food Value Equation Survey by Deloitte Consulting LLP [1], safety issues has always been important factor influencing the food buying decision of consumers (Figure 1). Consequently, palm oil industry has to put serious effort to assure the safety of the palm oil produced. With increasingly consumer awareness regarding the relationship between food, safety, and health, the demand on food safety is also increasing and widening. Consumers not only concern about “traditional definition” of safety of “free of harmful elements”, but also demand more and more on other aspect and criteria not traditionally considered as part of safety definition, such as clear and accurate labeling, clear information, fewer ingredients, etc. (Figure 2).

In addition to addressing these consumers interest in food safety, palm oil industry also has to update themselves with nutritional issues, especially associated lipid nutrition. This nutritional issue is also increasingly pressing due to the growing importance of palm oil as food ingredients and/or as specialty oils/fats for food applications.

2. Challenges of Palm Oil Industry

The challenges of palm oil industry are how to respond appropriately with food safety issue, assuring the safety of palm oil. Keeping it safe, comply with food safety & nutrition standards and regulations, is a complex process that starts on the farm and ends with the consumer, and it require management commitment.

At international atmosphere, the reference of food safety and nutrition standard is international standard adopted by the CODEX Alimentarius Commission (CAC). The CAC is an intergovernmental standard-setting body established by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) in 1963.
Several standards relevant to palm oil, namely (i) Codex Standard for Named Vegetable Oils [CX-STAN 210 -1999], (ii) Code of Practice for the Storage and Transport of Edible Fats and Oils in Bulk [CAC/RCP 36 – 1987], and Code of Practice for the Reduction of 3-Monochloropropane-1,2- Diol Esters (3-MCPDEs) and Glycidyl Esters (GEs) in Refined Oils and Food Products Made with Refined Oils [CXC 79-2019].

The Codex Standard for Named Vegetable Oils [CX-STAN 210 -1999] applies to the vegetable oils, including many varieties of palm oil (palm kernel oil, palm kernel olein, palm kernel stearin, palm olein, palm stearin, palm superolein) presented in a state for human consumption. The standard describes provisions on chemical & physical characteristics of the oil, purity or authenticity of the oil; quality and stability aspects, and foreign substances and impurities of the oils. The Code of Practice for the Storage and Transport of Edible Fats and Oils in Bulk [CAC/RCP 36 – 1987] applies to the handling, storage and transport of all crude or processed edible oils and fats in bulk. This standard, particularly addresses contamination issues arising during storage, handling and transportation, including provisions on hygiene, cleanliness of storage tanks and tanks in transportation, and proper handling of oil to avoid contamination. Compliance to these standards is very important for palm oil industry; not only to protect public health but also to ensure fair practices in the food trade.

The other food safety challenges faced by the palm oil industry are related to the application of the Code of Practice for the Reduction of 3-Monochloropropane-1,2- Diol Esters (3-MCPDEs) and Glycidyl Esters (GEs) in Refined Oils and Food Products Made with Refined Oils [CXC 79-2019]. This relatively new Code of Practices (COP) is actually adopted by CAC only recently, during the forty-second session of the Codex Alimentarius Commission, held in Geneva, Switzerland 8-12 July 2019.

The COP was developed due to the fact that the substrates of 3-MCPDEs and GEs are contaminants found in vegetable oils, which are formed unintentionally during the refining processes of vegetable oil. The International Agency for Research on Cancer (IARC) lists 3-MCPD and glycidol as “possibly carcinogenic to humans” and the Joint FAO/WHO Expert Committee on Food Additives (JECFA) have assessed that 3-MCPDEs and GEs are potentially may cause public health concerns. So it is important to take action to reduce the levels of these compounds in refined oils and foods (containing refined oils) to a level as low as reasonably achievable.
Accordingly, the COP was written to provide guidance to reduce the formation of known toxic components (namely 3-MCPDEs and GEs) in refined oils and food products made with these oils. The COP is developed by explaining the importance of good management practices, started from the good agricultural practices, good manufacturing practices (oil milling & refining, and treatment post refining) and selection and uses of refined oils in food products made from these oils. The COP is intended to be applied by national authorities, producers, manufacturers and other relevant bodies to reduce the 3-MCPDEs and GEs in vegetable oils. With respect to 3-MCPD and GEs, palm oil industry have bigger challenge to be solved, as compared to other edible oils industry, because the contaminants have been found in greater quantity in palm oil.

To address these challenges, Indonesian palm oil industry has to be aware and ready to adapt and comply with standards. Nationally, however, Indonesia need to develop a national action plan, comprising of mitigation strategy to reduce MCPDE and GE in refined oils and foods (containing refined oils) as low as reasonably achievable. Implementation of a national action plan will have major effect in Indonesia, since palm oil is an important commodity and especially that 41% of palm oil producer in Indonesia is small farmers. A national action plan should identify specific need and strategy for small farmer, since (i) reduction of MCPDE and GE in refined oils as low as reasonably achievable will depend on the level of technology applied, and (ii) to ensure that small farmers will not be left behind.

3. Opportunity of Palm Oil Industry

Palm oil has a long history of safe uses and there are no health concerns specific to palm oil. Palm oil has unique fatty acid composition (Table 1), with approximately 50% saturated fatty acids, comprising of 44% palmitic acid (C16:0), 4.5% stearic acid (C18:0), and 1.1% myristic acid (C14:0). Another 50% is the unsaturated fatty acids, comprising of about 39.2% oleic acid (C18:1) and 10.1% linoleic acid (C18:2) and 0.4% linolenic acid (C18:3).

Due to its unique composition of fatty acids, palm oil and its fractions are excellent choices for food manufacturers because of its nutritional benefits and versatility. Without the need of hydrogenation making palm oil a naturally trans fat–free oil, a good alternative for partially hydrogenated vegetable oils (PHVO).

Table 1. Fatty acid composition of palm oil

| Fatty acid (%) | Typical | Range | Range |
|----------------|---------|-------|-------|
| Lauric acid (C12:0) | 0.0 | 0.1–1.0 | 0.0–0.4 |
| Myristic acid (C14:0) | 1.1 | 0.9–1.5 | 0.5–2.0 |
| Palmitic acid (C16:0) | 44.0 | 41.8–46.8 | 40.0–48.0 |
| Palmitoleic acid (C16:1) | 0.1 | 0.1–0.3 | 0.0–0.6 |
| Stearic acid (C18:0) | 4.5 | 4.5–5.1 | 3.5–6.5 |
| Oleic acid (C18:1) | 39.2 | 37.3–40.8 | 36.0–44.0 |
| Linoleic acid (C18:2) | 10.1 | 9.1–11.0 | 6.5–12.0 |
| Linolenic acid (C18:3) | 0.4 | 0.4–0.6 | 0.0–0.5 |
| Arachidic acid (C20:0) | 0.4 | 0.2–0.7 | 0.0–1.0 |

PHVO has been identified as the primary dietary source of artificial trans fat in processed foods. With increasingly convincing evidence that trans fat of PHVO increase coronary heart diseases (CHD) risk factors and CHD events. Consequently, many government started the initiatives to remove PHVOs from processed foods to prevent heart attacks and deaths. The first restrictions of the use of PHVO was done in 2003, when the Government of Denmark set the 2% limit of trans fat for any food ingredient. Many countries has done the same actions. In January 2006, USFDA started to require the food industry to declare the amount of trans fat in food on the Nutrition Facts label. In November 2013, USFDA made a preliminary
determination that PHV Os are not “generally recognized as safe” (GRAS) for use in food, and finally in June 2015, USFDA has released its final determination that PHVOs are not GRAS [2].

Furthermore, WHO calls on the fats, oils and food industry, including the food service industry, to commit to reduce the trans fats, by the reformulating the foods to eliminate industrially-produced trans fat. This condition provide a great opportunity for palm oil industry. Palm oil industry and community should explore the potential of palm oil as a replacer of “PHVOs, by taking advantage the unique fatty acids composition of palm oil. At the same time, however, the palm oil producing country need to develop and manage the proper science-based risk communication related to trans fats and saturated fats, for the betterment of public health.

Another opportunity for palm oil industry is due to its content of minor nutrient with health promoting properties (Loganathan et al. 2008). Such minor nutrient of palm oil, constitute only about 1% of the weight of crude palm oil, are vitamin E, carotenoids, phytosterols, squalene, co-enzyme Q10, and polyphenols commonly known as phyttonutrient (Table 2).

Table 2. Palm Phytonutrient and its potential health Promoting Properties [8]

| Palm phytonutrients | Concentration | Health benefits |
|---------------------|--------------|-----------------|
| Vitamin E           | 600-1000 ppm | • Anti-cancer effects<br/>• Anti-angiogenesis<br/>• Antioxidant<br/>• Anti-arterosclerosis<br/>• Anti-ageing<br/>• Inhibition of cholesterol synthesis<br/>• Cardio-protection effects<br/>• Aid diabetes<br/>• Pro-vitamin A activity |
| Carotenoids         | 500-700 ppm  | • Cardio-protection effects<br/>• Anti-cancer<br/>• Cardio-protective effects<br/>• Anti-cancer<br/>• Brain development |
| Phytosterols        | 300-620 ppm  | • Cholesterol lowering properties<br/>• Cardio-protective effects |
| Squalene            | 250-540 ppm  | • Inhibition of cholesterol synthesis<br/>• Anti-cancer<br/>• Brain development |
| Phospholipids       | 20-100 ppm   | • Energy endurance<br/>• Eases digestion and nutrition absorption<br/>• Enhance production of cellular energy |
| Co-enzyme Q10       | 10-80 ppm    | • Antioxidative defence mechanism<br/>• Cardio-protective effects<br/>• Anti-cancer<br/>• Cholesterol inhibition |
| Polyphenolics       | 40-70 ppm    | • Aids various circulation problems<br/>• Anti-cancer |

4. Conclusions
As conclusion, opportunities of palm oil to fulfil growing consumer demand of safe and versatile edible oil is huge. This potential can be realized by Indonesia palm oil industry by appropriately addressing the challenges in ensuring safety and quality of palm oil. Indonesia palm oil need to establish safety/quality assurance system using a “from farm to fork” approach, covering the entire supply chain (production,
handling, transportation, and service chains) of palm oil and involving all of palm oil stakeholders, such as
government, private sector, farmers and consumers. Attention to small farmers, especially to improve
management and technology capacity, should be a priority. Stakeholders of palm oil industry in
Indonesia should seriously consider establishing a National (Indonesian) Palm Oil Authority to more
effectively addressing issues related to food safety, quality, traceability, and sustainability of palm oil.

References
[1] Anonymous. 2016. Consumer survey shows changing definition of food safety Food Safety News
(https://www.foodsafetynews.com/2016/02/123246/#.W1aWXdUzbIV)
[2] Anonymous. 2015. Final determination regarding partially hydrogenated oils (removing trans fat)
(https://www.fda.gov/food/food-additives-petitions/final-determination-regarding-partially-
hydrogenated-oils-removing-trans-fat)
[3] Firestone D. 2006. Physical and chemical characteristics of oils, fats, and waxes (2nd ed.). (Champaign:
AOCS Press)
[4] Woittiez L S, van Wijk M T, Slingerlanda M and van Noordwijk M. 2017. Yield gaps in oil palm: A
quantitative review of contributing factors Europ. J. Agronomy 83 57–77.
[5] May C Y. 2013. Palm oil: A versatile ingredient for food and non-food applications. Presentation
presented at Malaysia-Vietnam Palm Oil Trade Fair & Seminar 2013 (http://www.mpoc.
org.my/upload/PAPER_3-Datuk-Choo-Yuen-May-POTS-Vietnam_2013.pdf)
[6] O’Brien R D. 2010 Fats and Oils: Formulating and Processing for Applications (3rd ed.) (Florida: CRC
Press)
[7] Wisena B A, Daryanto A, Arifin B and Oktaviani R. 2014. Sustainable development strategy and the
competitiveness of Indonesian palm oil industry International Journal of Managerial Studies and
Research 2 102–15
[8] Loganathan R, Selvaduray K R, Radhakrishnan A, and Nesaretnam K. 2008. Palm oil: Rich in health
promoting phytonutrients Palm Oil Developments 50 16–6.