RECENT DEVELOPMENTS, CHALLENGES AND STRATEGIES FOR THE REDUCTION OF 3-MCPD ESTERS, GLYCIDOL ESTERS, MOSH-MOAH AND RELATED COMPOUNDS IN THE PALM OIL INDUSTRY

DR AZMIL HAIZAM AHMAD TARMIZI
Head of Analytical and Quality Development Unit
Malaysian Palm Oil Board

MPOB

KEMENTERIAN PERUSAHAAN
PERLADANGAN DAN KOMODITI

Presentation outline

01

Food safety versus food quality

02

Strategies to address food safety issues on 3-MCPDE and GE

03

New food safety challenge on mineral oil hydrocarbons

04

Quality development and standard for palm oil

05

Take home message

Why is food safety and quality so important for palm oil?

“…The most versatile ingredients for food products…”

89% of Malaysian palm oil exportation

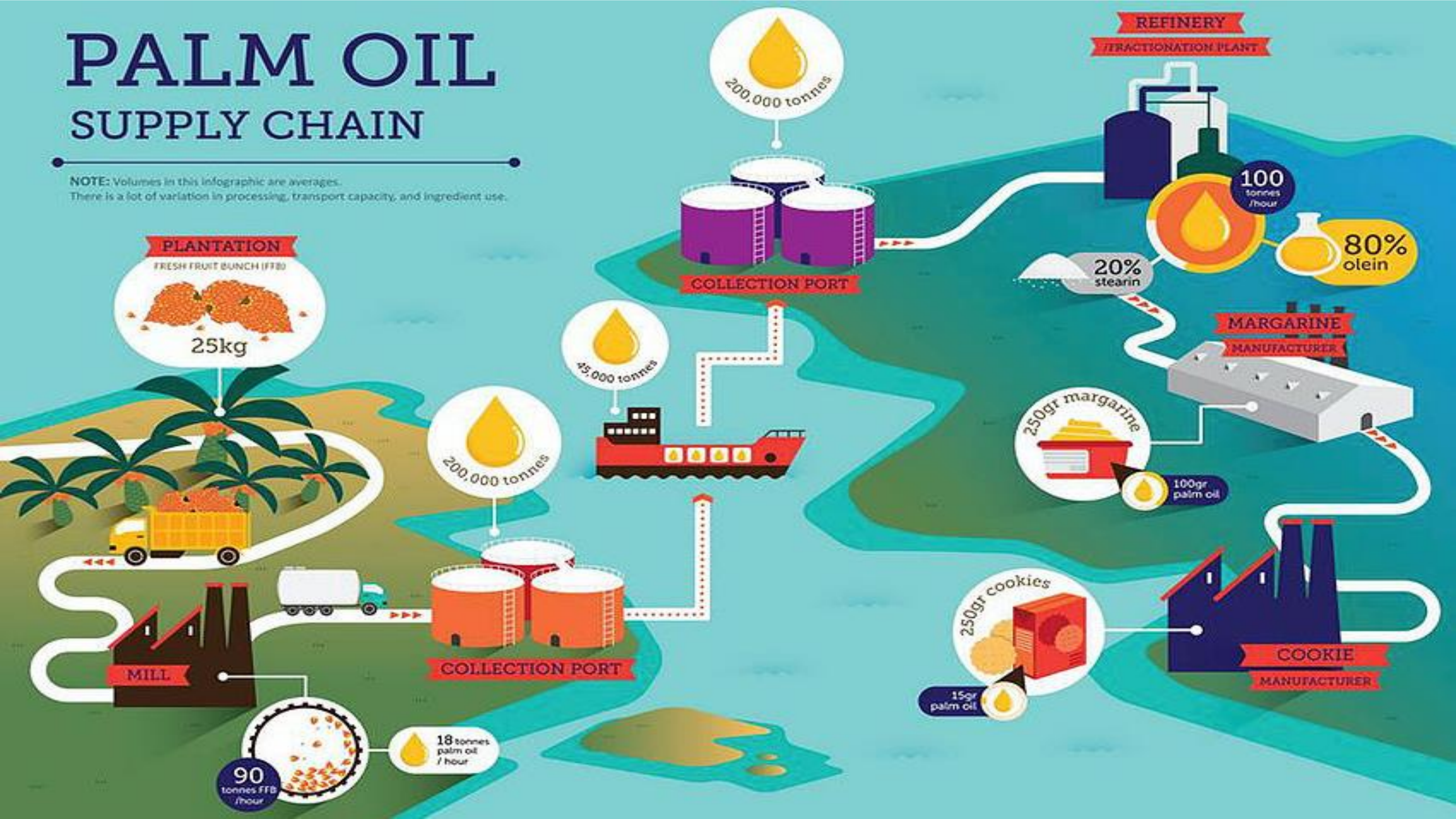
85% of palm oil is used in food products

- Cooking oil
- Specialty fat products
- Solid- and semi-solid fat industry
- Non-dairy based industry
- Snack foods
- Supplements
- Bakery products

PALM OIL

SUPPLY CHAIN

NOTE: Volumes in this infographic are averages.
There is a lot of variation in processing, transport capacity, and ingredient use.



Food safety versus food quality

Food Safety

Concept of prevention of diseases and health hazards, misuse of food additives, presence of contaminants, and adulteration that could detriment human health

Food Quality

Consumer attributes that influence the value of products

Rationale of food safety compliance

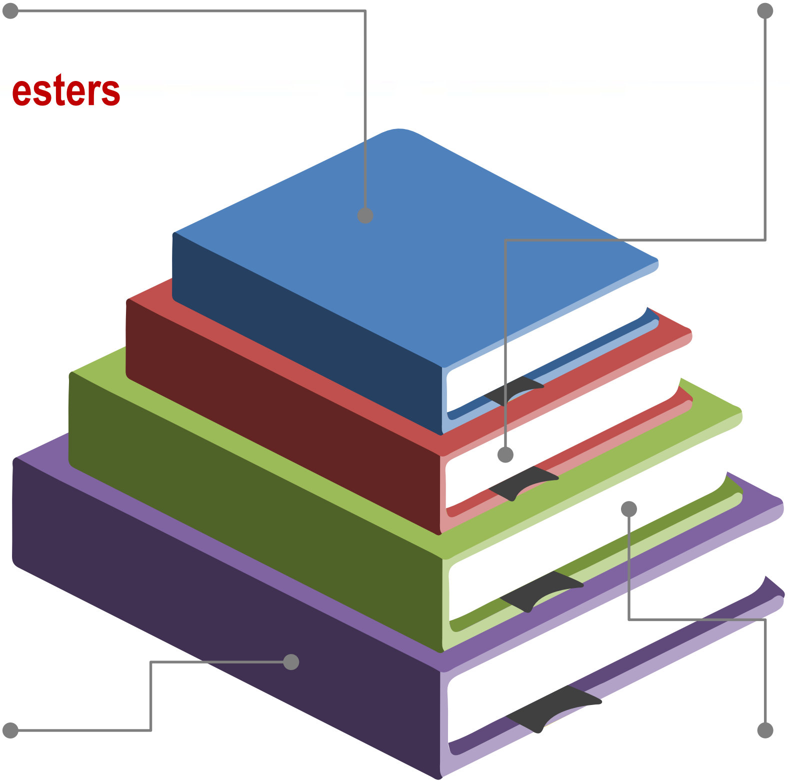
Food is the source of energy and nutrient for us to be healthy and fit

Food safety generally refers to food that will not impose to any health hazards for consumption

Food can be contaminated at any stages of production, distribution and preparation

Food safety is becoming the main criteria for international trade

Food safety challenges in palm oil



Thermal processes

- **3-monochloropropane-diol esters**
- **Glycidyl esters**
- Acrylamide
- *Trans*-fatty acids
- Polar compound fractions

UNCOMPROMISED
SAFETY

Pesticide residues

- Paraquat
- Glyphosate
- Glufosinate ammonium
- Hexaconazole

Environment

- **Mineral oil hydrocarbons**
- Polyaromatic hydrocarbons
- Dioxins
- Polychlorinated biphenyls
- **Chloride**
- Phosphorus
- Trace elements (Iron and Copper)

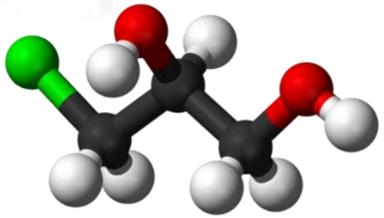
Mycotoxins

- Aflatoxins in palm kernel cake

3-monochloropropane-1,2-diol esters

HOT ISSUE

Glycidyl esters



EFSA Report on 3-MCPDE

"…In 3 May 2016, European Food Safety Authority (EFSA) press released a report that warned of the alleged dangers of contaminants that form during the processing of vegetable oils, particularly palm oil…"

European Food Safety Authority

Soybean oil is **394 µg kg^{-1}**

Sunflower seed oil is **521 µg kg^{-1}**

Rapeseed oil is **232 µg kg^{-1}**

Coconut oil is **608 µg kg^{-1}**

Palm oil / fat is **2,912 µg kg^{-1}**

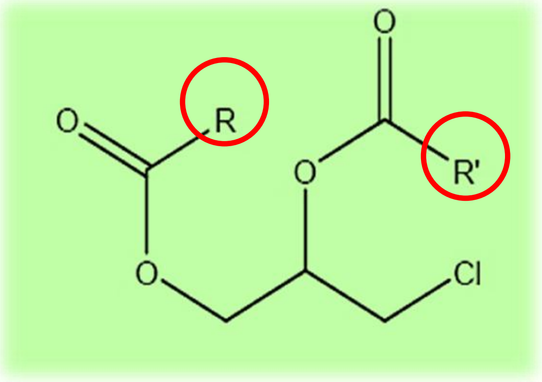
Palm kernel oil is **624 µg kg^{-1}**

Factors contributing to 3-MCPDE and GE in palm oil

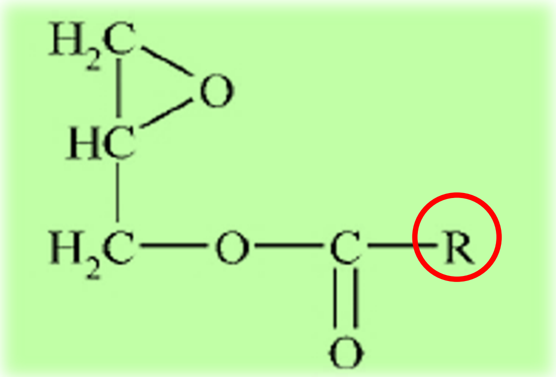
3-MCPDE is difficult to remove upon formation

Presence of chloride (as the precursor) in crude palm oil (CPO)

Catalyzed by acid degumming, acid activated bleaching clay and high deodorization temperature of more than 230°C



3-MCPDE



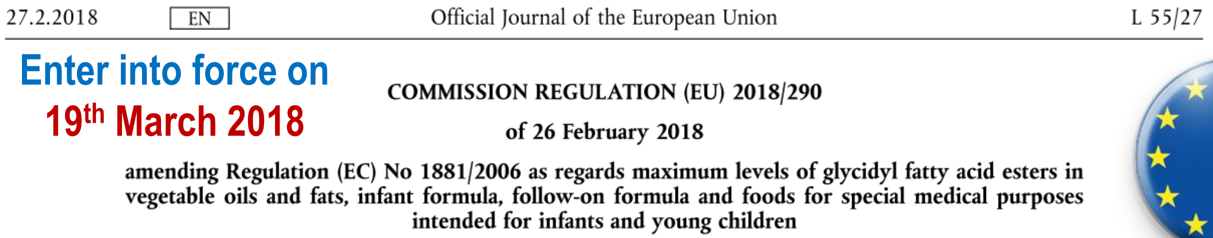
GE

Ensure CPO has low acidity (less than 4%) and DAG (~3%)

GE is developed from diacylglycerols (DAG) during refining between 260 and 270°C

Remove via post-refining at lower temperature (230°C)

GE is correlated with DAG content



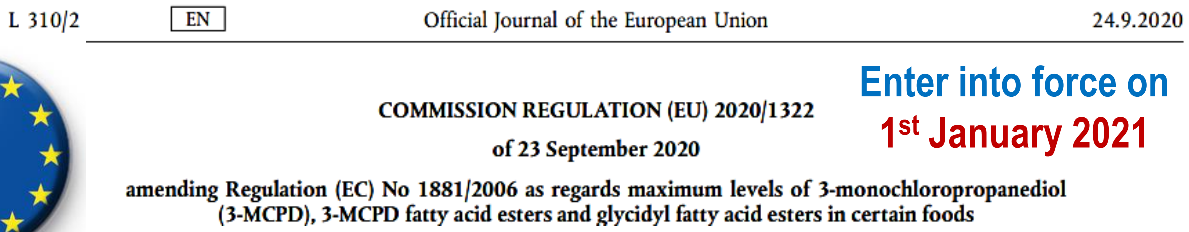
27.2.2018 EN Official Journal of the European Union L 55/27

COMMISSION REGULATION (EU) 2018/290

of 26 February 2018

amending Regulation (EC) No 1881/2006 as regards maximum levels of glycidyl fatty acid esters in vegetable oils and fats, infant formula, follow-on formula and foods for special medical purposes intended for infants and young children

Enter into force on
19th March 2018



L 310/2 EN Official Journal of the European Union 24.9.2020

COMMISSION REGULATION (EU) 2020/1322

of 23 September 2020

amending Regulation (EC) No 1881/2006 as regards maximum levels of 3-monochloropropanediol (3-MCPD), 3-MCPD fatty acid esters and glycidyl fatty acid esters in certain foods

Enter into force on
1st January 2021

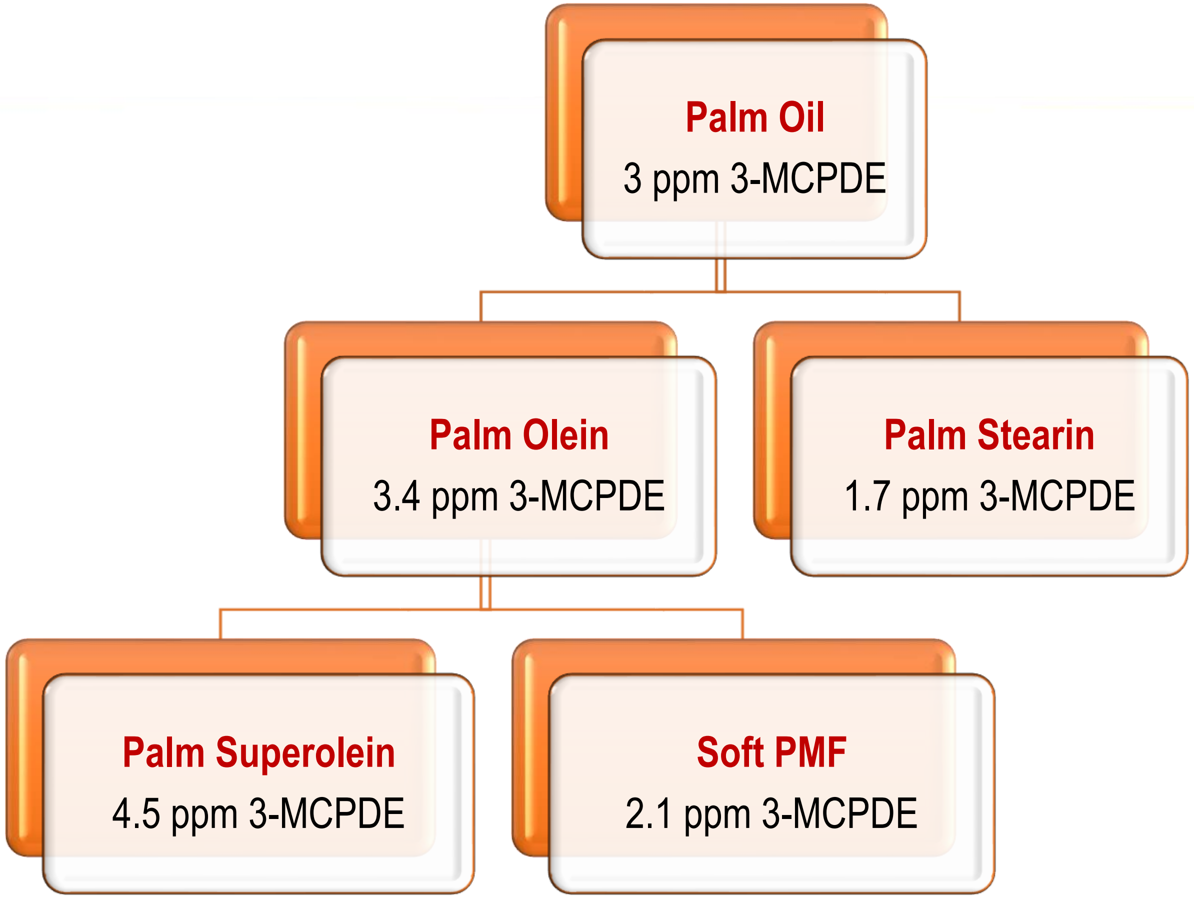
Item 4.2	Foodstuffs	Maximum GE
4.2.1	Vegetable oils and fats placed on the market for the final consumer or for use as an ingredient in food with the exception of the foods referred to item 4.2.2	1 ppm

Item 4.3	Foodstuffs	Maximum 3-MCPDE
4.3.1	Vegetable oils and fats, fish oils and oils from other marine organisms placed on the market for the final consumer or for use as an ingredient in food falling within the following categories, with the exception of the foods referred to in [2] and of virgin olive oils and fats from coconut, maize, rapeseed, sunflower, soybean, palm kernel and olive oils (composed of refined olive oil and virgin olive oil) (and mixtures of oils and fats with oils and fats only from this category)	1.25 ppm
	Other vegetable oils (including pomace olive oils), fish oils and oils from other marine organisms and mixtures of oils and fats with oils and fats only from this category	2.5 ppm
	Mixtures of oils and fats from the two above mentioned categories	2.5 ppm

Distribution of 3-MCPDE in palm oil and its fractions

"…Partitioning of 3-MCPDE is higher in liquid portions regardless to fractionation stage…"

Palm Oil	Palm Olein	Superolein
1.00 ppm	1.16 ppm	1.53 ppm
0.65 ppm	0.76 ppm	1.00 ppm
0.81 ppm	0.95 ppm	**1.25 ppm**
1.63 ppm	1.90 ppm	**2.50 ppm**
1.08 ppm	**1.25 ppm**	-
2.16 ppm	**2.50 ppm**	-



Palm Oil
3 ppm 3-MCPDE

Palm Olein
3.4 ppm 3-MCPDE

Palm Stearin
1.7 ppm 3-MCPDE

Palm Superolein
4.5 ppm 3-MCPDE

Soft PMF
2.1 ppm 3-MCPDE

REFERENCE

HINRECHSEN, N (2015). Minimization of 3-MCPD and glycidyl fatty acid esters in food matrices. DGF Symposium on MCPD Esters and Glycidyl Esters. 20 to 21 April 2016, Berlin, Germany

Levels of 3-MCPDE and GE in cooking oils from local stores

FOOD ADDITIVES & CONTAMINANTS: PART A
https://doi.org/10.1080/19440049.2019.1654139

Verification and evaluation of monochloropropanediol (MCPD) esters and glycidyl esters in palm oil products of different regions in Malaysia

Raznim Arni Abd. Razak[a], Azmil Haizam Ahmad Tarmizi[a], Abdul Niefaizal Abdul Hammid[a], Ainie Kuntom[a], Intan Safinar Ismail[b,c] and Maimunah Sanny[d,e]

[a]Product Development and Advisory Services Division, Malaysian Palm Oil Board, 6, Persiaran Institusi, Kajang, 43000, Malaysia; [b]Department of Chemistry, Faculty of Science, Universiti Putra Malaysia, Serdang, Malaysia; [c]Laboratory of Natural Products, Institute of Bioscience, Universiti Putra Malaysia, Serdang, Malaysia; [d]Department of Food Science, Faculty of Food Science and Technology, Universiti Putra Malaysia, Serdang, Malaysia; [e]Laboratory of Food Safety and Food Integrity, Institute of Tropical Agriculture and Food Security, Universiti Putra Malaysia, Serdang, Malaysia

ABSTRACT
This study was conducted to investigate on the effect of different sampling regions of palm-refined oils and fats on the 2- and 3-monochloropropanediol fatty acid esters (MCPDE) and glycidol fatty acid esters (GE) levels. The American Oil Chemists' Society (AOCS) Official Method Cd 29a-13 on the determination of MCPDE and GE in edible oils and fats by acid transesterification was successfully verified and optimised, with slight modification using 7890A Agilent GC system equipped with 5975C quadrupole detector. The determined limits of detection (LOD) for MCPDE were 0.02 mg kg^{-1} and 0.05 mg kg^{-1} for GE. The method performance has showed good recovery between 80% and 120% for all pertinent compounds with seven replicates assayed in three separate days. Round robin test with two European laboratories, i.e. Eurofins and SGS, has shown compliance results with those of the present study. Among the sampling regions, only one refinery located in the central region of Malaysia showed a significant increment of the MCPDE and GE levels after refining process. The GE level averaging at 2.5 mg kg^{-1} was slightly higher than that of 3-MCPDE averaging at 1.3 mg kg^{-1}. Both esters were preferentially partitioned into the liquid phase rather than the solid phase after fractionation. However, the overall results exhibited no direct correlation between the esters content and the different sampling locations of the palm oil products in Malaysia. Analysis of total chlorine content also displayed significant variations between sampling locations which clearly show its effect on the chlorine content in the CPO samples.

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Monochloropropanediol (MCPD) esters; palm oil products; glycidol fatty acid esters; refining oils

Introduction

Production of vegetable oils mainly involves three processes comprising of milling, refining and fractionation. These processes principally remove components such as oxidation products, free fatty acids (FFAs), phospholipids, pigments, trace metals and other impurities (Ramli et al. 2011). However, food processing contaminants such as 3-monochloropropane-1,2-diol fatty acid esters (3-MCPDE) and glycidol fatty acid esters (GE) are formed due to high deodorisation temperature at the refining stage. The 3-MCPDE were initially found in foods (Divinova et al. 2004; Svejkovska et al. 2004), and later 3-MCPDE and GE were detected in all refined vegetable oils at different concentration levels (Zelinková et al. 2006; Kushairi et al. 2018). The mechanism of 3-MCPDE formation was suggested to be linked to the preliminary heat treatment of the oilseeds and oil refining process (Razak et al. 2012). In relation to toxicological evaluation, there are still insufficient human studies to conclude the possible effects of long term 3-MCPDE and GE exposure at different concentrations (Kushairi et al. 2018). However, there are many animal studies have been carried out as reported by the European Food Safety Authority Knutsen et al. (2018). Most of the animal studies were conducted on rats of which the kidney and the testis were the main target organs for the free 3-MCPD. With regards to regulations, the European Commission (EC) has established a maximum level of GE at 1.0 mg kg^{-1} for vegetable oils and fats and

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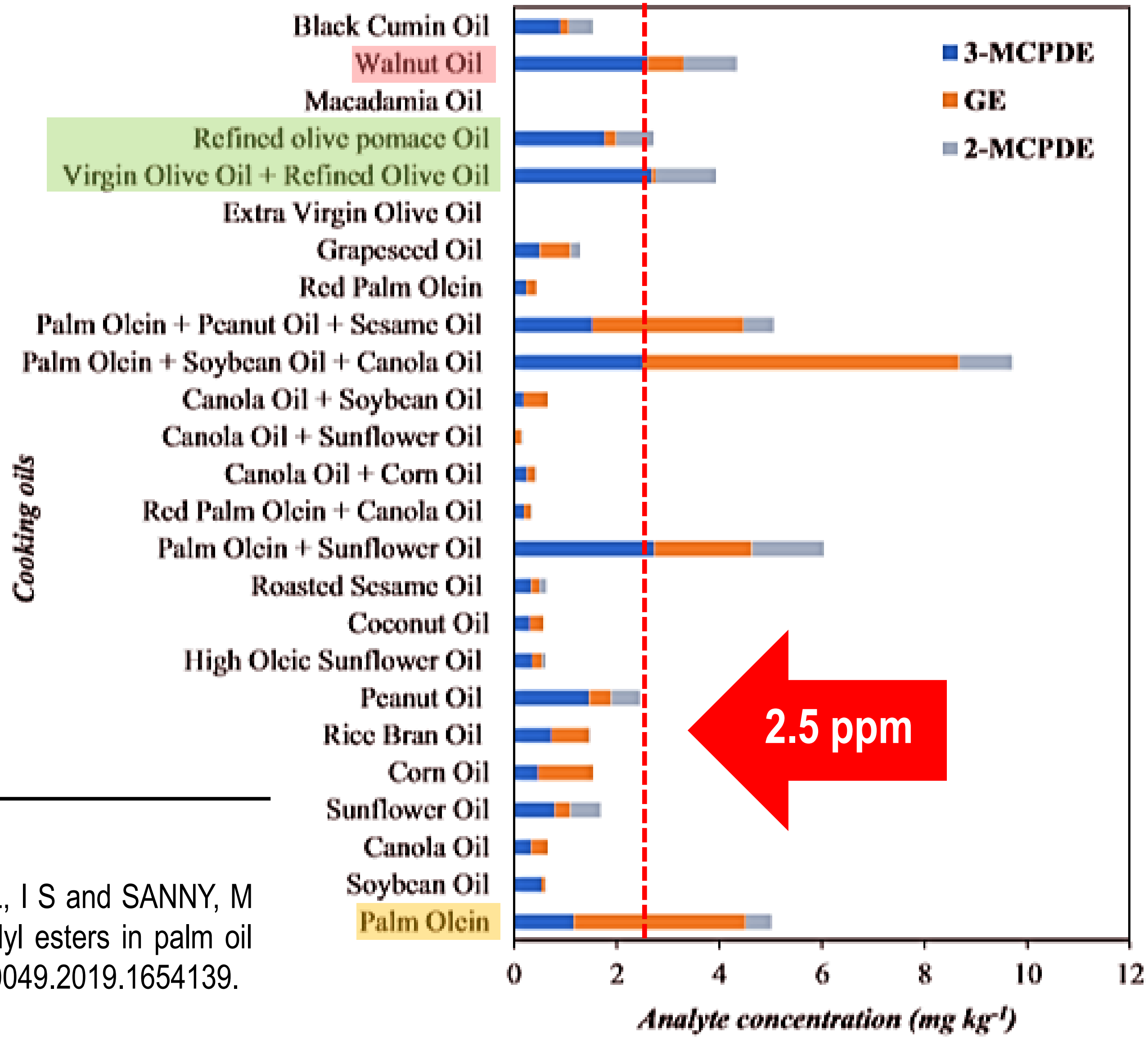
CONTACT Intan Safinar Ismail safinar@upm.edu.my Department of Chemistry, Faculty of Science, Universiti Putra Malaysia, Serdang, Selangor 43400 UPM, Malaysia; Laboratory of Natural Products, Institute of Bioscience, Universiti Putra Malaysia, Serdang, Selangor 43400 UPM, Malaysia

Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/tfac.



REFERENCE

ABD RAZAK, R A, AHMAD TARMIZI, A H, ABDUL HAMMID, A N, KUNTOM, A, ISMAIL, I S and SANNY, M (2019). Verification and evaluation of monochloropropanediol (MCPD) esters and glycidyl esters in palm oil products of different regions in Malaysia. *Food Add. Contam.: Part A*. DOI: 10.1080/19440049.2019.1654139.

Mitigation of 3-MCPDE and GE across palm oil supply chain

Mitigation Approaches

Plantations

Reduce chlorine in FFB by alternative fertilisers

Reduce DAG in PO by ensuring milling within 48 hours

Mills

Wash FFB to remove chlorine precursor

FFB sterilisation with steam without chlorine

Segregate secondary oils from mixing with fresh CPO

Refineries

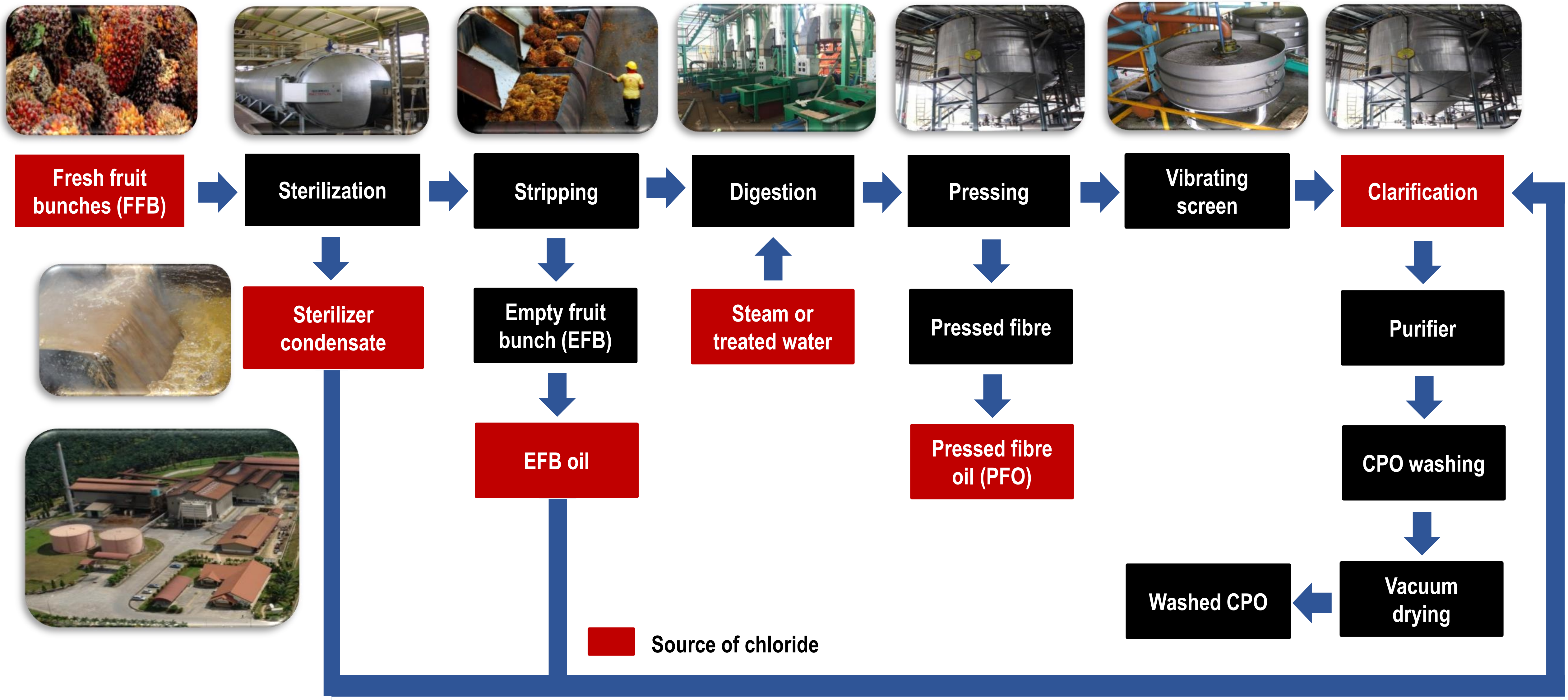
Use natural bleaching earth

Lower deodorisation temperature to less 230°C at vacuum pressure of 1 mbar

🟦 3-MCPDE

🟧 GE

Source of chloride at oil palm plantation and palm oil mill



Fresh fruit bunches (FFB)

Sterilization

Sterilizer condensate

Stripping

Empty fruit bunch (EFB)

EFB oil

Digestion

Steam or treated water

Pressing

Pressed fibre

Pressed fibre oil (PFO)

Vibrating screen

Clarification

Purifier

CPO washing

Vacuum drying

Washed CPO

🟥 Source of chloride

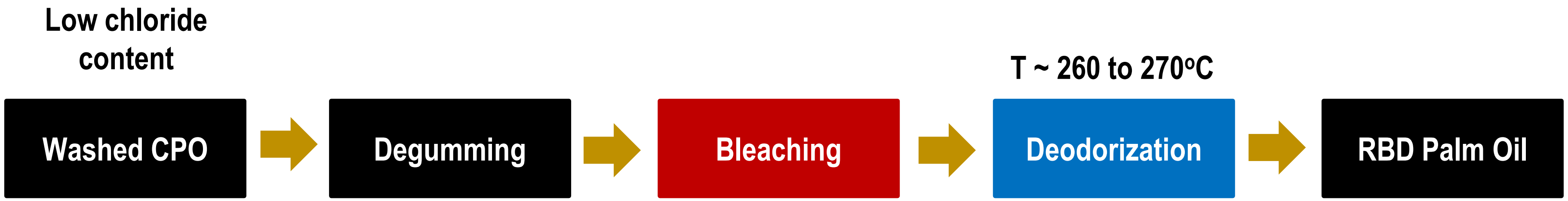
Mitigation of 3-MCPDE and GE across palm oil supply chain

🟥 Source of chloride

🟦 Formation of 3-MCPDE and GE

🟩 Reduction of GE

REFINING

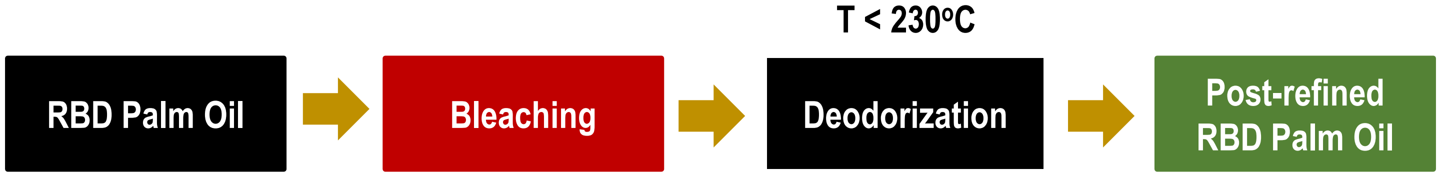


Low chloride content

T ~ 260 to 270°C

Washed CPO → Degumming → Bleaching → Deodorization → RBD Palm Oil

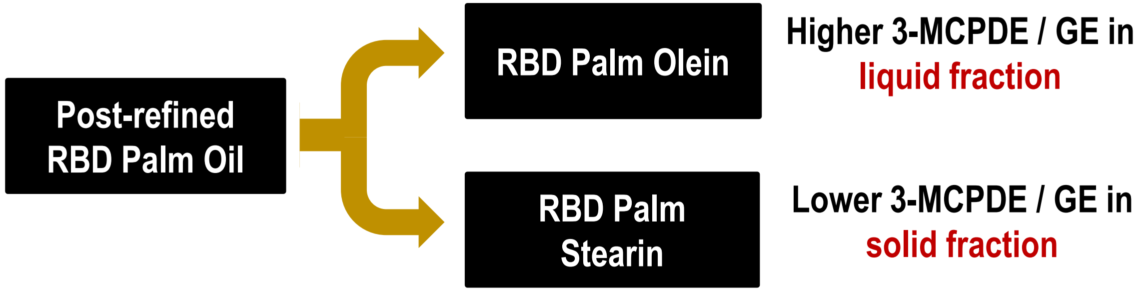
POST-REFINING



T < 230°C

RBD Palm Oil → Bleaching → Deodorization → Post-refined RBD Palm Oil

FRACTIONATION



Post-refined RBD Palm Oil → RBD Palm Olein / RBD Palm Stearin

RBD Palm Olein: Higher 3-MCPDE / GE in liquid fraction

RBD Palm Stearin: Lower 3-MCPDE / GE in solid fraction

MALAYSIA'S EFFORTS IN ADDRESSING 3-MCPDE AND GE IN PALM OIL

MPOB research and activities associated to 3-MCPDE and GE

2009

Research initiation on 3-MCPDE in refined palm oil at laboratory and pilot scales

2010

Adopt and establish the analysis of 3-MCPDE following BfR Method 008

2011 - 2013

Conduct surveys on commercial palm oil products and other cooking oils

Extensive pilot plant trials for the mitigation of 3-MCPDE during palm oil refining

2014

Adopt and establish the analysis of 3-MCPDE and GE using AOCS Method Cd 29a

2016 - 2018

Identify the potential technology providers to team up with the industry in mitigating 3-MCPDE and GE

Industrial trials at the selected mills and refineries to lowering TCC in CPO, and/or 3-MCPDE and GE in processed PO

2019 - 2020

Industry engagements, discussions, forums

New low-cost system to remove TCC in CPO

2021 - 2022

Initiate trials on low-cost system at different mills

New low-cost system to remove TCC in CPO

MPOB Pilot Trials

66

Washing of CPO can reduce the formation of 3-MCPDE

FFA and DAG are not directly correlated to 3-MCPDE formation

High deodorisation temperature led to high formation of the 3-MCPDE

Acid degumming followed by bleaching causes formation of 3-MCPDE in bleached oil

Research grants on the mitigation of 3-MCPDE and GE

Research Fund from Malaysian Government

10

MILLS

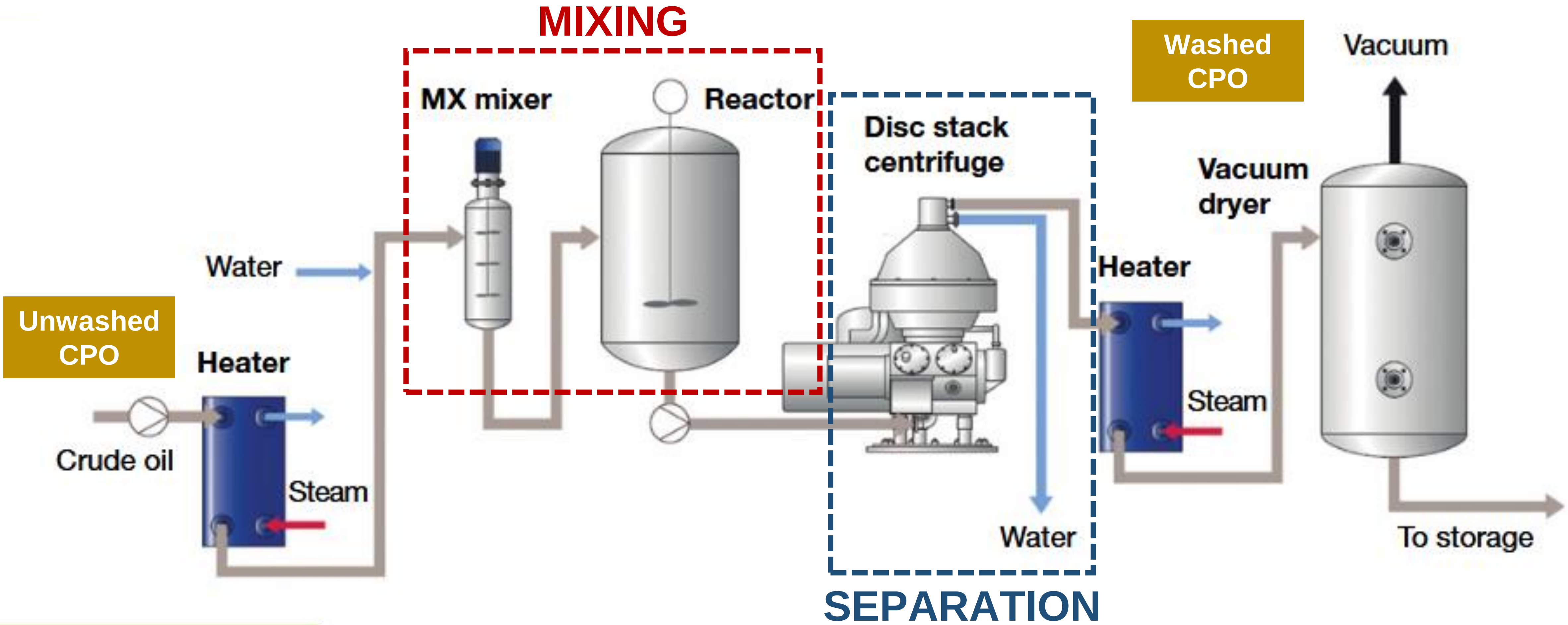
6

REFINERIES

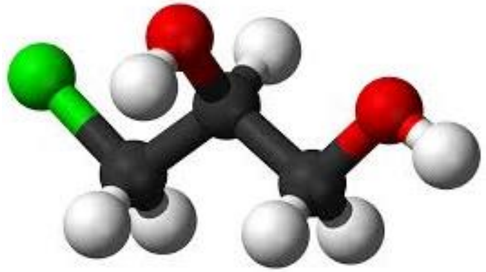
Malaysian Government has allocated substantial amount of research grant for strategizing the mitigation of 3-MCPDE and GE at the mills and refineries

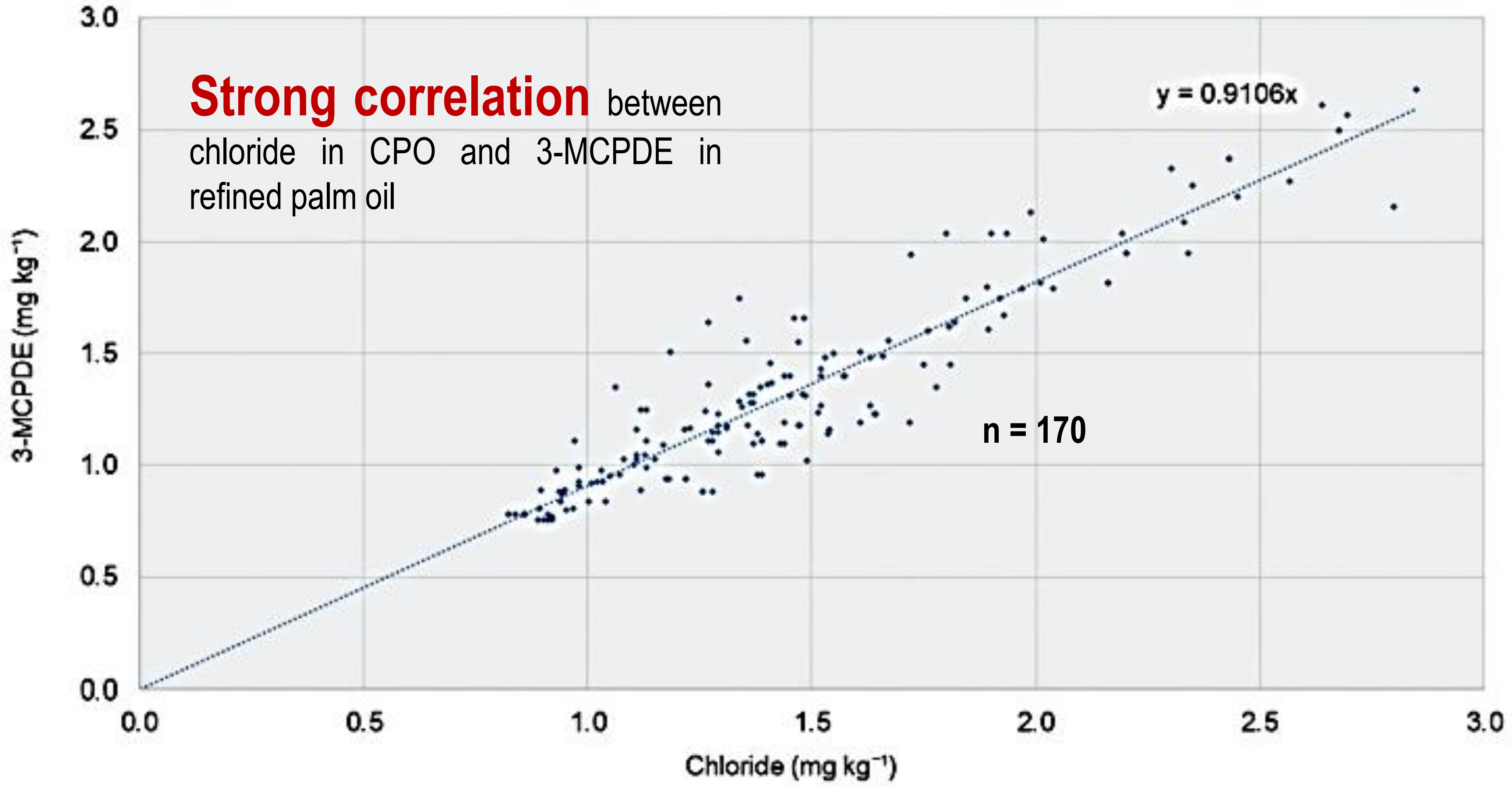
- ☑ **Chloride removal in CPO at the mills and refineries**
- ☑ **Process to reduce the level of 3-MCPDE and GE at the refineries**

Typical flowchart of commercial CPO washing system



Correlation between 3-MCPDE and chloride content



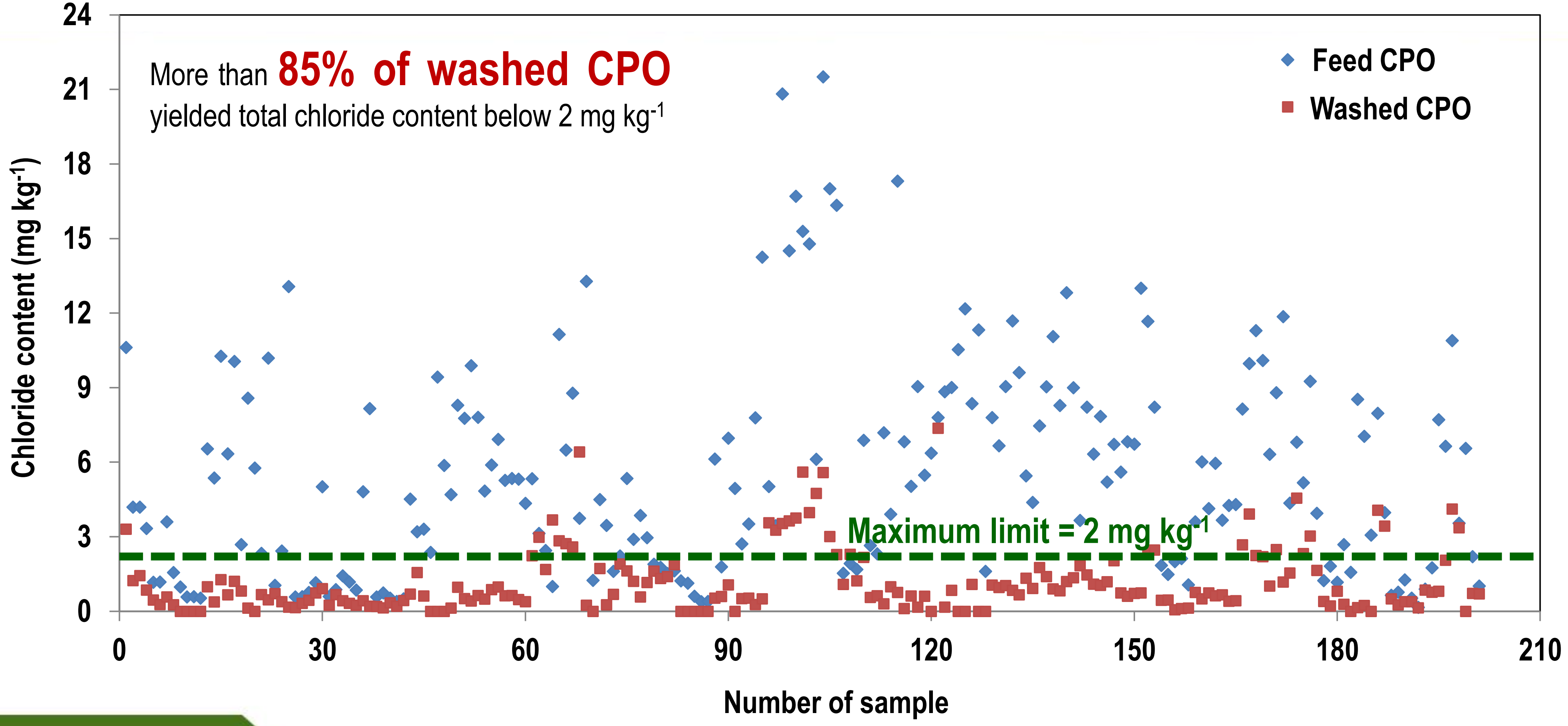


Strong correlation between chloride in CPO and 3-MCPDE in refined palm oil

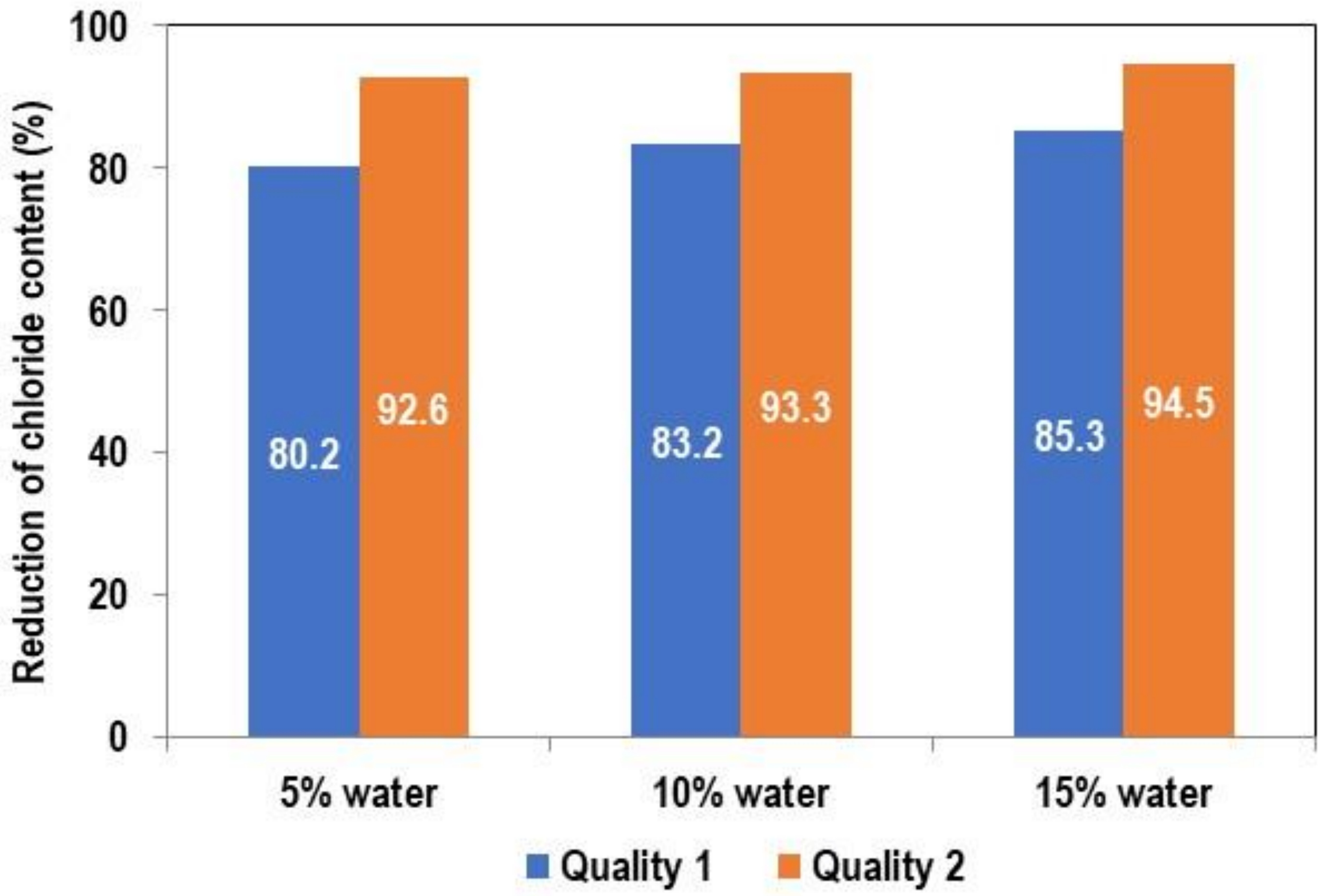
REFERENCE

LAKSHAMANAN, S AND YEN, L Y (2020). Chloride reduction by water washing of crude palm oil to assist in 3-monochlropropane-1,2-diol ester (3-MCPDE) mitigation, *Food Add. Contam.: Part A*. DOI: 10.1080/19440049.2020.1842516.

Chloride removal in CPO using conventional washing plant



Chloride removal at different water dosage and CPO quality



Parameters	Crude Palm Oil	
	Quality 1	Quality 2
FFA (%)	4.3	3.8
M&I (%)	0.234	0.125
DOBI	2.25	2.58
PV (meq O_2 kg^{-1})	2.1	0.8

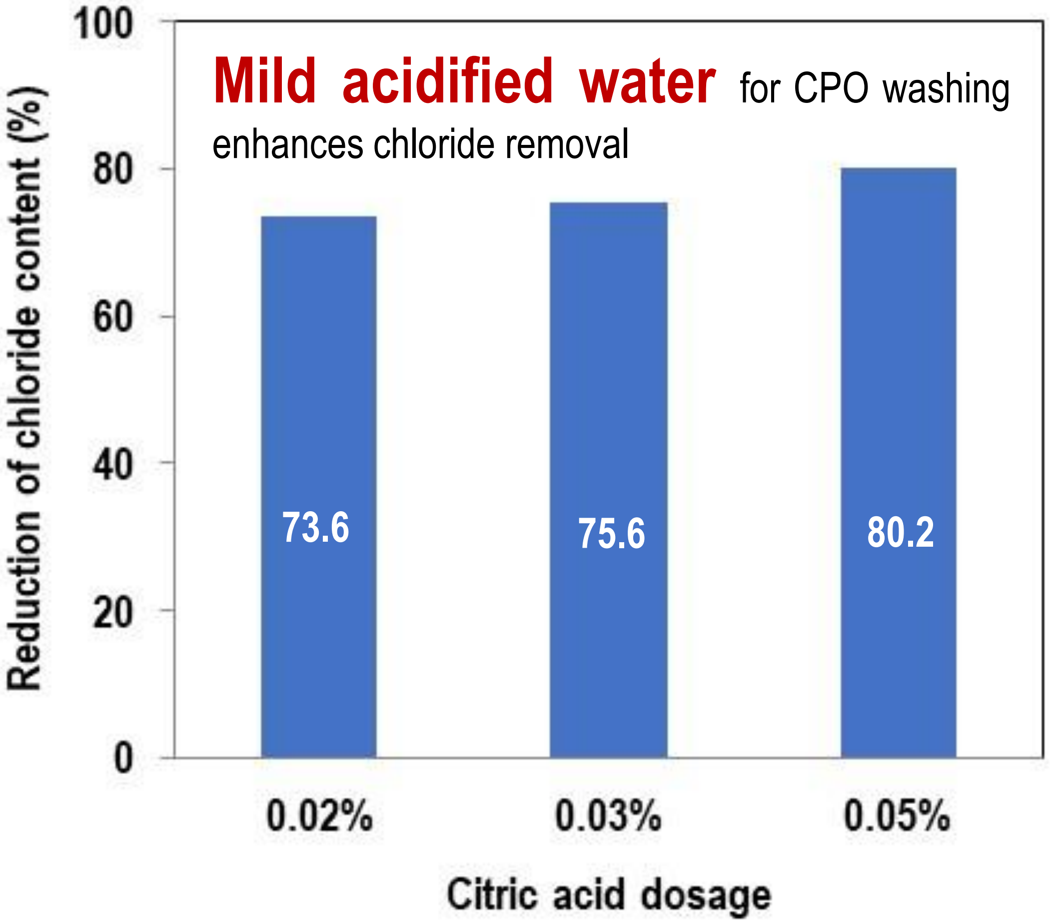
Increase in water dosage

marginally improves the reduction of chloride content

Quality of crude palm oil

significantly impacting the removal rate of chloride content

Acidification of CPO wash water for chloride removal at refinery



Parameters	Unwashed CPO	Washed CPO
FFA (%)	4.2 ± 0.3	4.1 ± 0.3
Impurities (%)	0.045 ± 0.004	0.010 ± 0.004
DOBI	2.3 ± 0.1	2.4 ± 0.1
PV (meq O_2 kg^{-1})	2.1 ± 0.7	2.1 ± 0.7
p-anisidine value (unit)	3.4 ± 0.7	2.0 ± 0.7
Iron (mg kg^{-1})	5.1 ± 0.7	4.2 ± 0.5
Phosphorus (mg kg^{-1})	15.6 ± 0.9	11.9 ± 0.7
Chloride content (mg kg^{-1})	7.6 ± 0.9	2.0 ± 0.2
3-MCPDE in PPO (mg kg^{-1})	4.5 ± 1.3	1.2 ± 0.1

REFERENCE

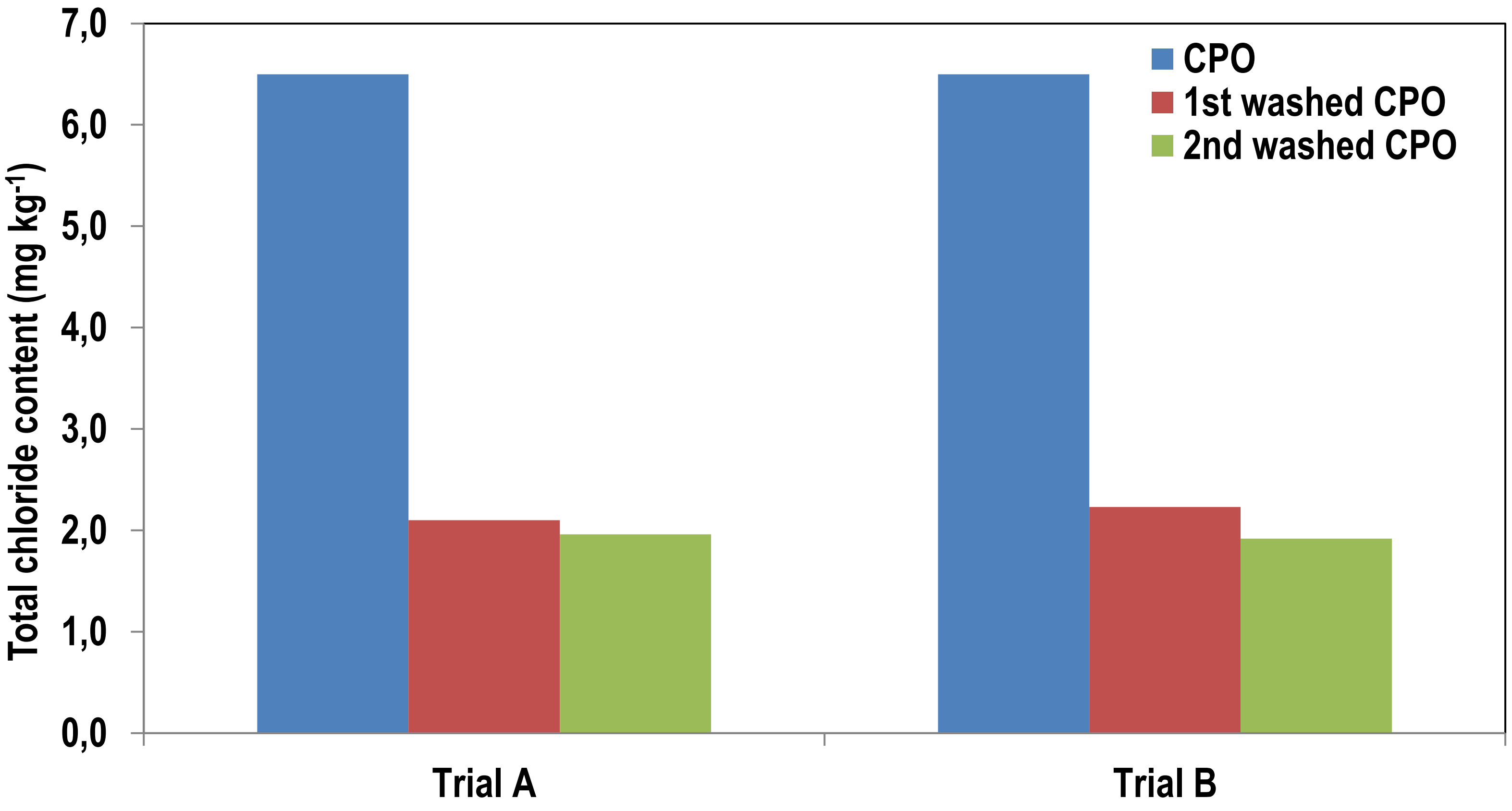
LAKSHAMANAN, S AND YEN, L Y (2020). Chloride reduction by water washing of crude palm oil to assist in 3-monochlropropane-1,2-diol ester (3-MCPDE) mitigation, *Food Add. Contam.: Part A*. DOI: 10.1080/19440049.2020.1842516.

Double CPO washing for chloride removal at refinery

Chloride removal from 66% to 68% of after 1st CPO washing

Further chloride removal from 7% to 14% after 2nd CPO washing

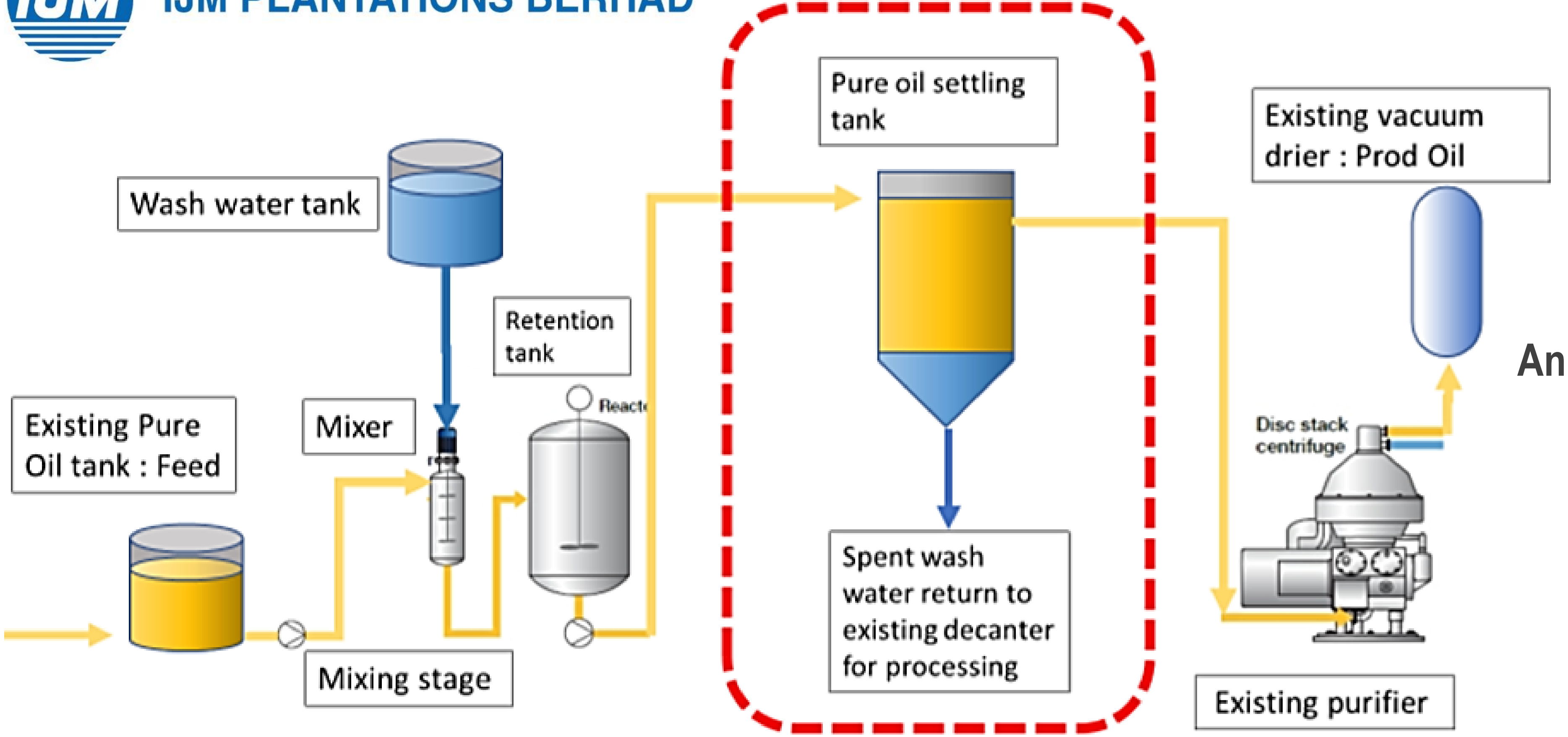
Phosphorus removal from 47% to 68% after CPO washing



Innovation of low-cost CPO washing system at the mill

IJM PLANTATIONS BERHAD

Replacement of separator in typical CPO washing system



Wash water tank

Existing Pure Oil tank : Feed

Mixer

Mixing stage

Retention tank

Pure oil settling tank

Spent wash water return to existing decanter for processing

Existing vacuum drier : Prod Oil

Existing purifier

PI 2020001572

An Oil-Water Separation System

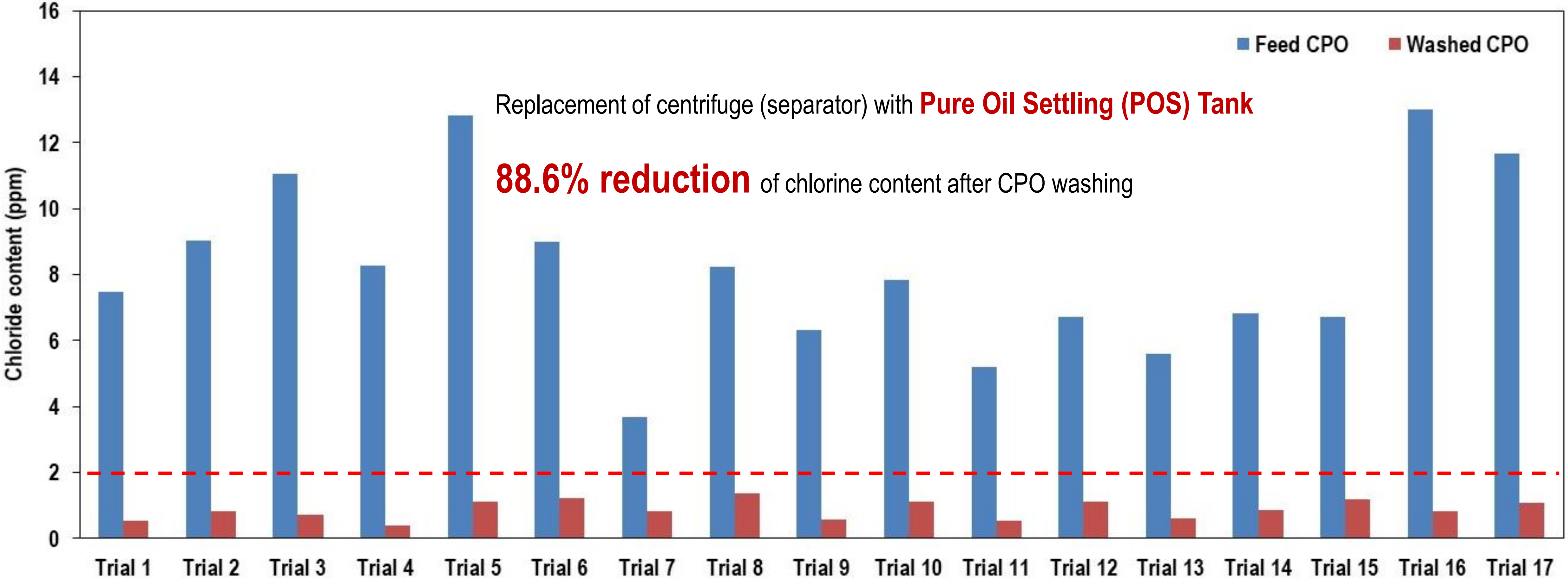
Project site

Desa Talisai Palm Oil Mill, Sandakan

Mill capacity

12 MT CPO h^{-1} or 60 MT FFB $^{-1}$

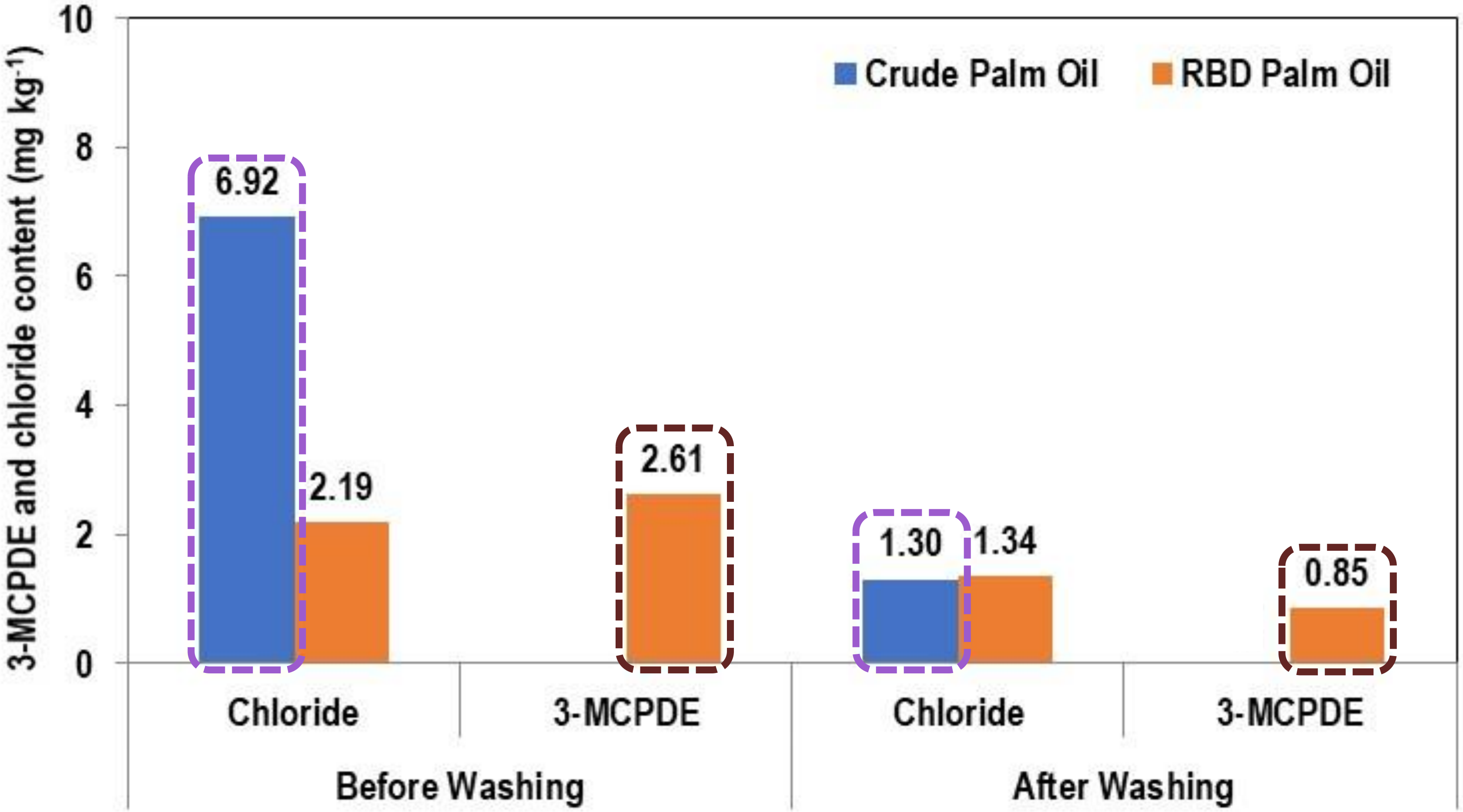
Chloride removal in CPO using an Oil-Water Separation System



Replacement of centrifuge (separator) with **Pure Oil Settling (POS) Tank**

88.6% reduction of chlorine content after CPO washing

Chloride removal through CPO washing at the mill

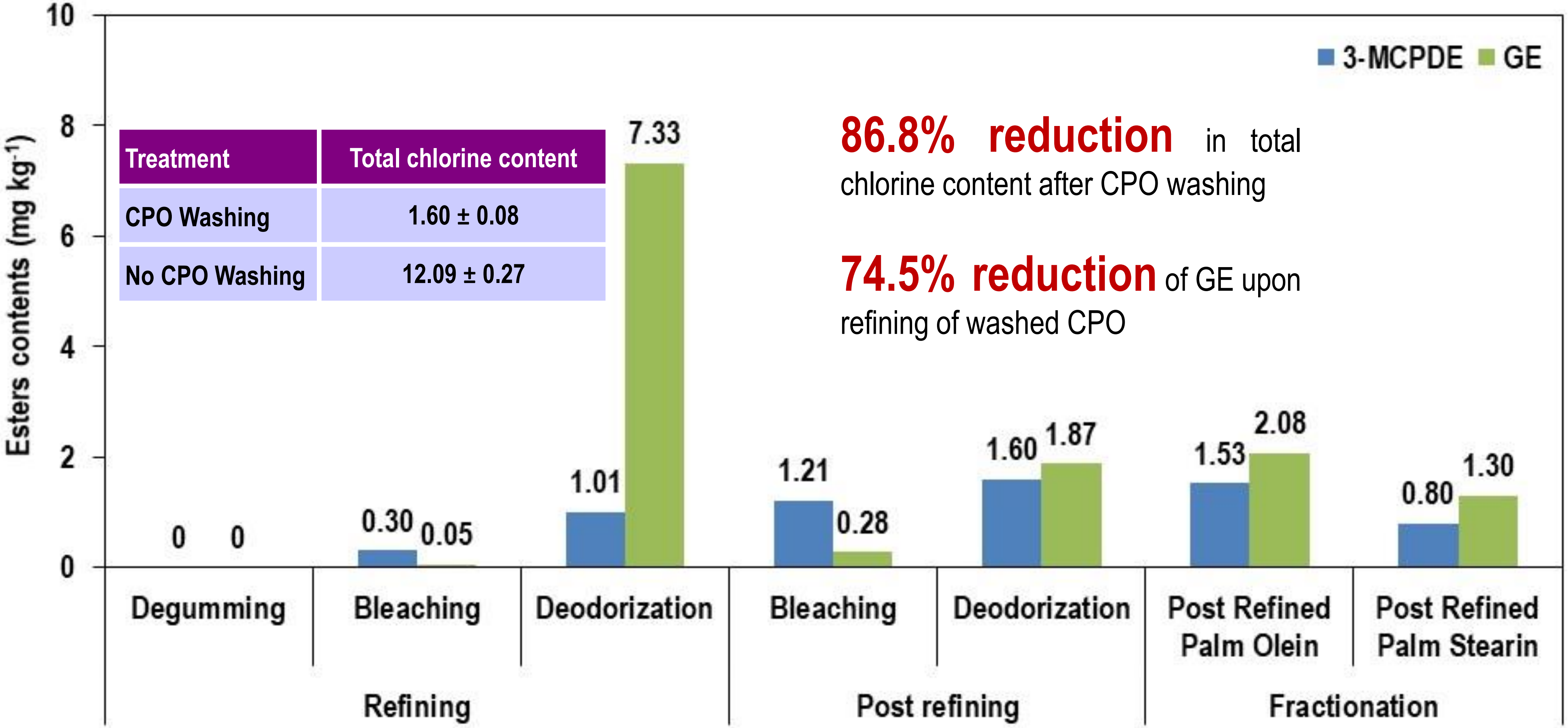


81.2% reduction in total chlorine content after CPO washing

67.4% reduction in 3-MCPDE upon refining of washed CPO

- ✪ CPO washing at Commercial Mill
- ✪ RBDPO from washed and unwashed CPO using lab-scale glass refining

CPO washing and refining on 3-MCPDE and GE



Treatment	Total chlorine content
CPO Washing	1.60 ± 0.08
No CPO Washing	12.09 ± 0.27

86.8% reduction in total chlorine content after CPO washing

74.5% reduction of GE upon refining of washed CPO

* CPO washing at Commercial Mill

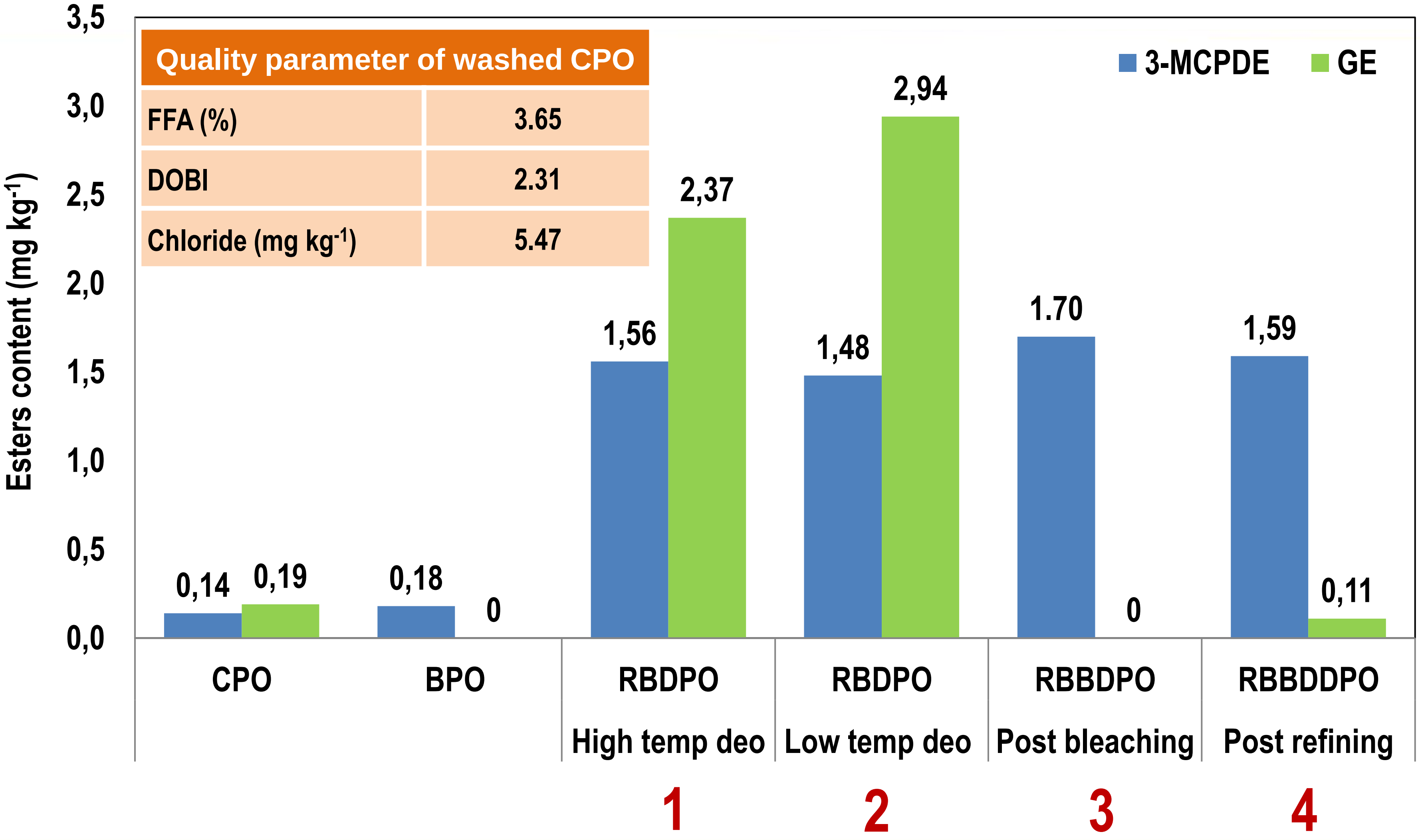
** Refining, post-refining at fractionation of washed CPO at Commercial Refinery

Dual deodorisation and post refining for 3-MCPDE and GE reduction

Insignificant difference in 3-MCPDE when applying dual deodorisation and post refining

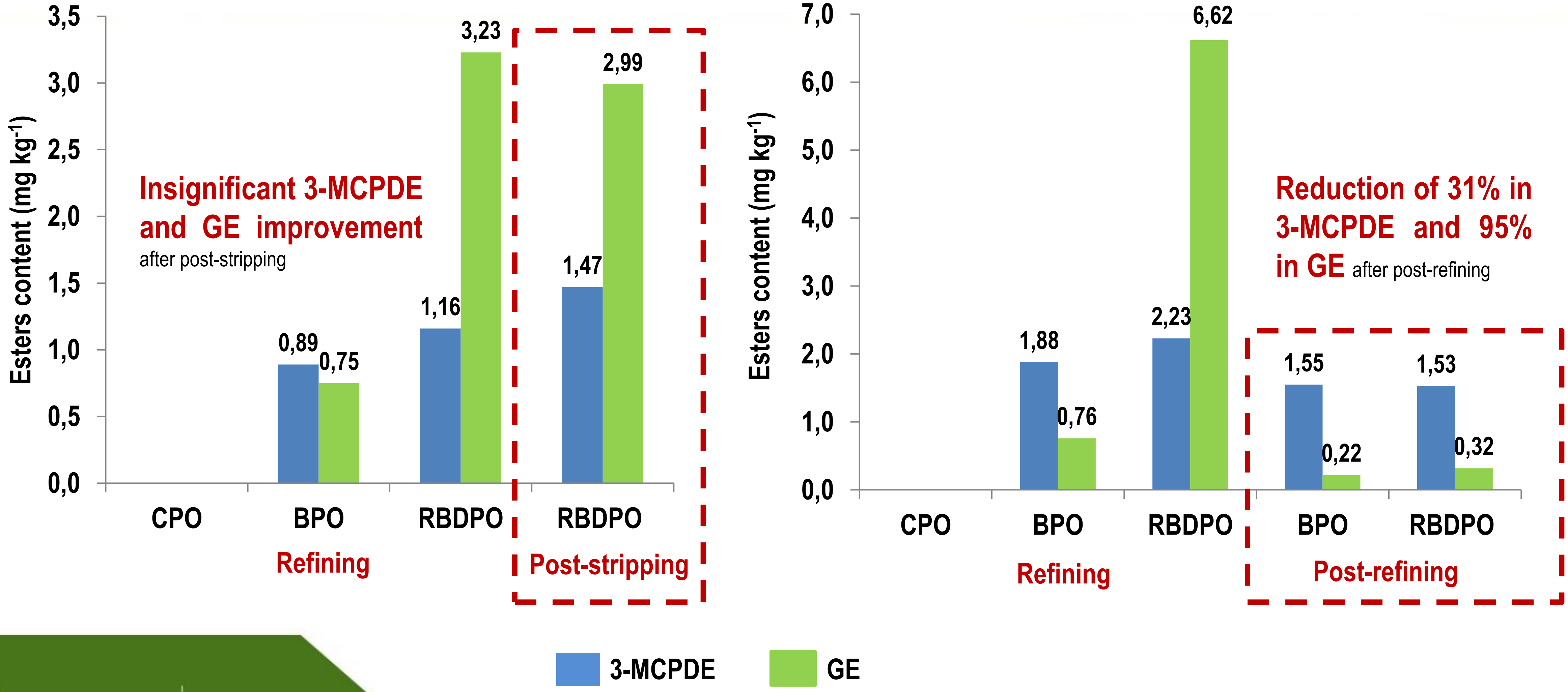
Significant reduction in GE when applying dual deodorisation and post refining

RBDPO from unwashed CPO	
3-MCPDE (mg kg^{-1})	2.8 to 3.7
GE (mg kg^{-1})	3.4 to 6.0



Quality parameter of washed CPO	
FFA (%)	3.65
DOBI	2.31
Chloride (mg kg^{-1})	5.47

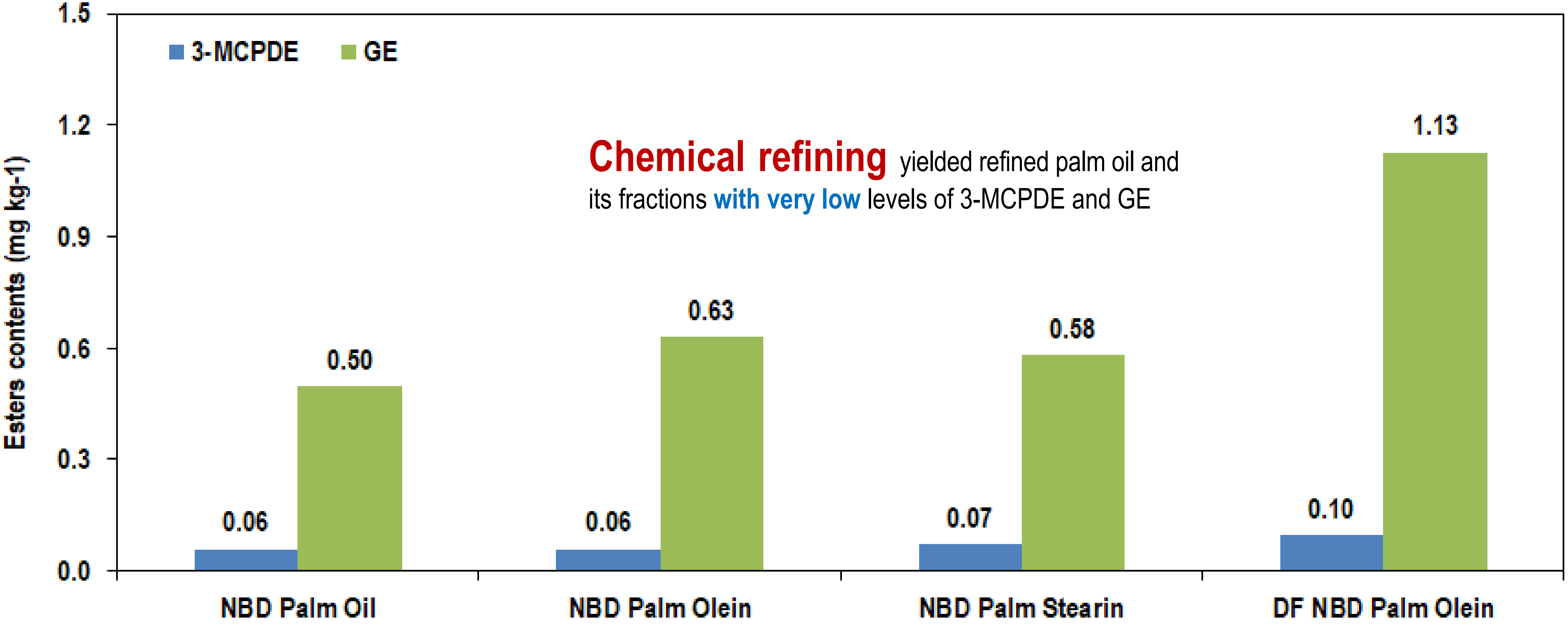
Post-refining *versus* post-stripping for 3-MCPDE and GE removal



Insignificant 3-MCPDE and GE improvement after post-stripping

Reduction of 31% in 3-MCPDE and 95% in GE after post-refining

Chemical refining on 3-MCPDE and GE content in palm oil



Chemical refining yielded refined palm oil and its fractions **with very low** levels of 3-MCPDE and GE

Involvement in Codex Committee on Contaminants in Food (CCCF)

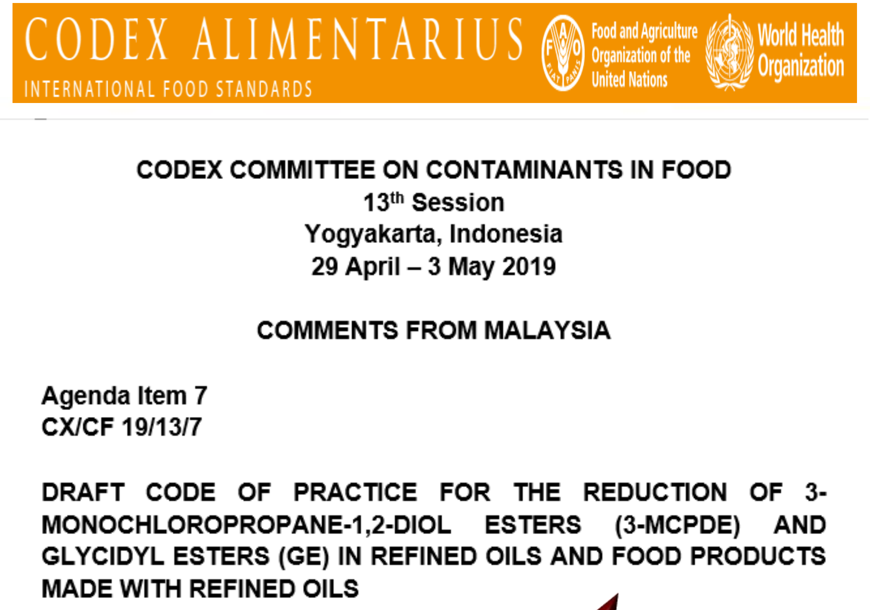
CODEX Alimentarius Commission (CAC) 40 on 17 to 22 July 2017 has approved the new work on Code of Practice (COP) for the reduction of 3-MCPDE and GE in refined oils and products made from refined oils especially infant formula

Establishment of the Electronic Working Group (eWG) is chaired by USA and co-chaired by EU and Malaysia

CCCF 12 (12 to 16 March 2018) adopted the COP at Step 5 and approved by CAC 41 (2 to 6 July 2018) in Rome, Italy

CCCF 13 (29 April to 3 May 2019) in Yogyakarta adopted the COP at Step 8

CAC 42 (8 to 12 July 2019) approved the COP in Geneva, Switzerland



CODEX ALIMENTARIUS
INTERNATIONAL FOOD STANDARDS
Food and Agriculture Organization of the United Nations
World Health Organization

CODEX COMMITTEE ON CONTAMINANTS IN FOOD
13th Session
Yogyakarta, Indonesia
29 April – 3 May 2019

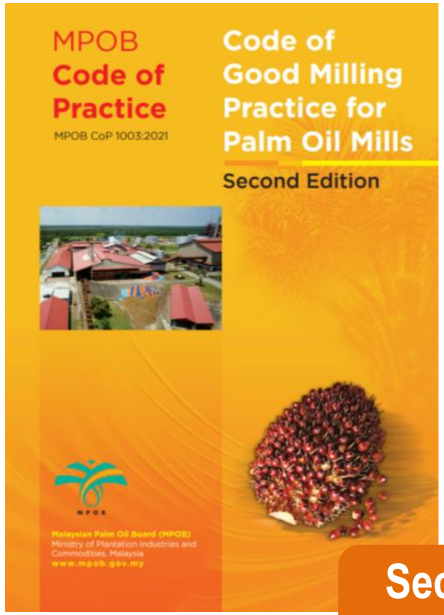
COMMENTS FROM MALAYSIA

Agenda Item 7
CX/CF 19/13/7

DRAFT CODE OF PRACTICE FOR THE REDUCTION OF 3-MONOCHLOROPROPANE-1,2-DIOL ESTERS (3-MCPDE) AND GLYCIDYL ESTERS (GE) IN REFINED OILS AND FOOD PRODUCTS MADE WITH REFINED OILS

CCCF will **POSSIBLY PROPOSE** the NWIP on the maximum limits for 3-MCPDE and GE in 2022

Revision of MPOB Code of Good Milling Practice for Palm Oil Mills



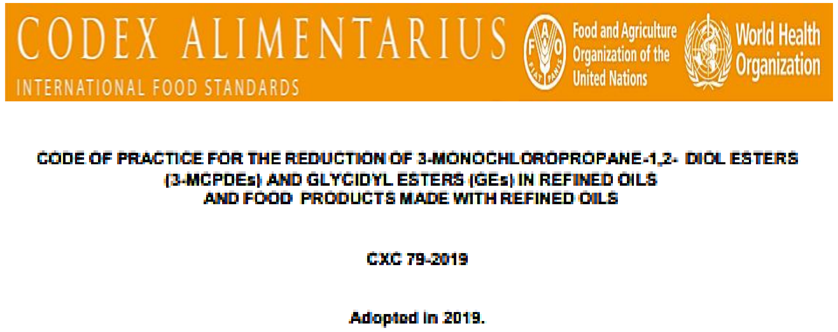
MPOB
Code of Practice
MPOB CoP 1003:2021

Code of Good Milling Practice for Palm Oil Mills
Second Edition

Malaysian Palm Oil Board (MPOB)
Ministry of Plantation Industries and Commodities, Malaysia
www.mpob.gov.my

Second edition is now available from Q2 2022

=



CODEX ALIMENTARIUS
INTERNATIONAL FOOD STANDARDS
Food and Agriculture Organization of the United Nations
World Health Organization

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

Adopted in 2019.

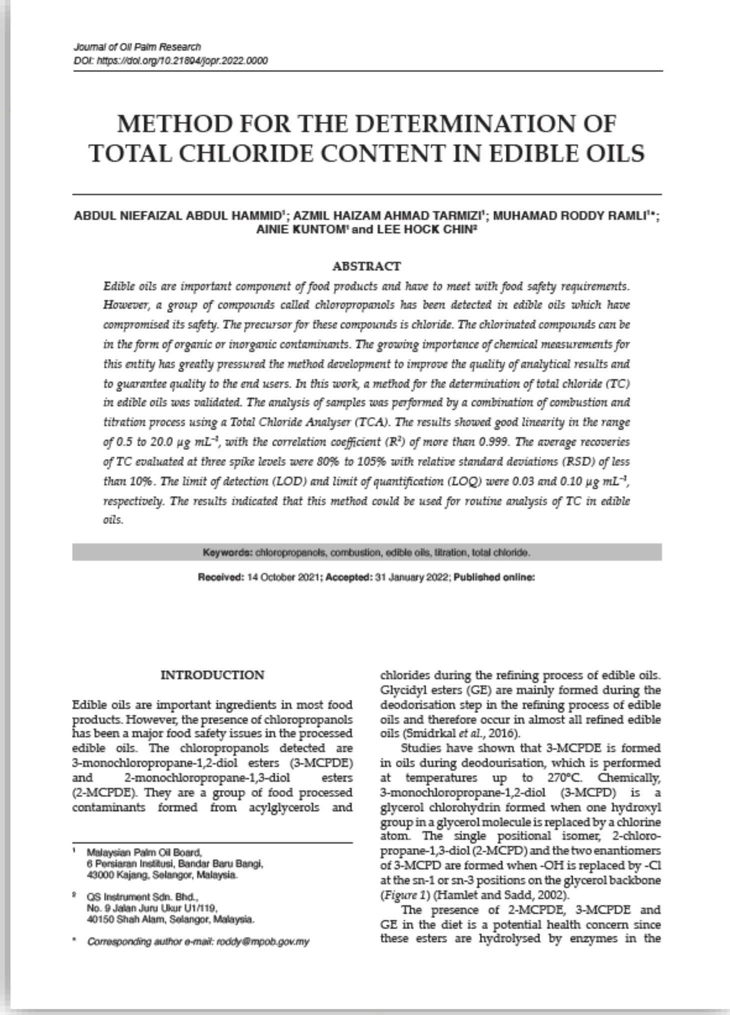
+

MAKANAN SELAMAT TANGGUNGJAWAB INDUSTRI
MeSTI
KEMENTERIAN KESIHATAN MALAYSIA

Minimum certification requirement for food premises by the Ministry of Health Malaysia

Strengthening of **MPOB Code of Good Milling Practice for Palm Oil Mills** coincides with ***Code of Practice for the Reduction 3-monochloropropane-1,2-diol Ester (3-MCPDE) and Glycidyl Esters (GE) in Refined Oils and Products Made from Refined Oils Especially for Infant Formula*** *and* ***Makanan Selamat Tanggungjawab Industri (MeSTI)*** scheme as part of elements in **MSPO certification**

Establishment of detection method TCC in edible oils



Journal of Oil Palm Research
DOI: https://doi.org/10.21894/jopr.2022.0000

METHOD FOR THE DETERMINATION OF TOTAL CHLORIDE CONTENT IN EDIBLE OILS

ABDUL NIEFAIZAL ABDUL HAMMID[1]; AZMIL HAIZAM AHMAD TARMIZI[1]; MUHAMAD RODDY RAMLI[1]*; AINIE KUNTOM[1] and LEE HOCK CHIN[2]

ABSTRACT

Edible oils are important component of food products and have to meet with food safety requirements. However, a group of compounds called chloropropanols has been detected in edible oils which have compromised its safety. The precursor for these compounds is chloride. The chlorinated compounds can be in the form of organic or inorganic contaminants. The growing importance of chemical measurements for this entity has greatly pressured the method development to improve the quality of analytical results and to guarantee quality to the end users. In this work, a method for the determination of total chloride (TC) in edible oils was validated. The analysis of samples was performed by a combination of combustion and titration process using a Total Chloride Analyser (TCA). The results showed good linearity in the range of 0.5 to 20.0 $\mu g\ mL^{-1}$, with the correlation coefficient (R^2) of more than 0.999. The average recoveries of TC evaluated at three spike levels were 80% to 105% with relative standard deviations (RSD) of less than 10%. The limit of detection (LOD) and limit of quantification (LOQ) were 0.03 and 0.10 $\mu g\ mL^{-1}$, respectively. The results indicated that this method could be used for routine analysis of TC in edible oils.

Keywords: chloropropanols, combustion, edible oils, titration, total chloride.

Received: 14 October 2021; **Accepted:** 31 January 2022; **Published online:**

INTRODUCTION

Edible oils are important ingredients in most food products. However, the presence of chloropropanols has been a major food safety issues in the processed edible oils. The chloropropanols detected are 3-monochloropropane-1,2-diol esters (3-MCPDE) and 2-monochloropropane-1,3-diol esters (2-MCPDE). They are a group of food processed contaminants formed from acylglycerols and chlorides during the refining process of edible oils. Glycidyl esters (GE) are mainly formed during the deodorisation step in the refining process of edible oils and therefore occur in almost all refined edible oils (Smidrkal *et al.*, 2016).

Studies have shown that 3-MCPDE is formed in oils during deodourisation, which is performed at temperatures up to 270°C. Chemically, 3-monochloropropane-1,2-diol (3-MCPD) is a glycerol chlorohydrin formed when one hydroxyl group in a glycerol molecule is replaced by a chlorine atom. The single positional isomer, 2-chloro-propane-1,3-diol (2-MCPD) and the two enantiomers of 3-MCPD are formed when -OH is replaced by -Cl at the sn-1 or sn-3 positions on the glycerol backbone (*Figure 1*) (Hamlet and Sadd, 2002).

The presence of 2-MCPDE, 3-MCPDE and GE in the diet is a potential health concern since these esters are hydrolysed by enzymes in the

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[1] Malaysian Palm Oil Board,
6 Persiaran Institusi, Bandar Baru Bangi,
43000 Kajang, Selangor, Malaysia.

[2] QS Instrument Sdn. Bhd.,
No. 9 Jalan Juru Ukur U1/119,
40150 Shah Alam, Selangor, Malaysia.

* *Corresponding author e-mail: roddy@mpob.gov.my*

Designation: D 4929 – 04

An American National Standard

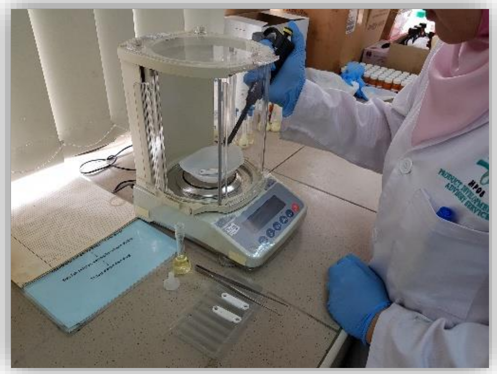
Standard Test Methods for Determination of Organic Chloride Content in Crude Oil[1]

TEST METHOD B—COMBUSTION AND MICROCOULOMETRY

18. Apparatus

18.1 *Combustion Furnace*—The sample specimen is to be oxidized in an electric furnace capable of maintaining a temperature of 800°C to oxidize the organic matrix.

18.2 *Combustion Tube*—Fabricated from quartz and constructed so a sample, which is vaporized completely in the inlet section, is swept into the oxidation zone by an inert gas where it mixes with oxygen and is burned. The inlet end of the tube shall hold a septum for syringe entry of the sample and side arms for the introduction of oxygen and inert gases. The center section is to be of sufficient volume to ensure complete oxidation of the sample.



TCC in crude and refined palm oil, and commercial cooking oils

No	Samples	Total chloride (μg mL^{-1}) (mean ± SD)
1	Crude palm oil	6.86 ± 0.49
2	Crude palm oil	4.51 ± 0.51
3	Crude palm oil	5.67 ± 1.08
4	Crude palm oil	3.91 ± 0.32
5	Crude palm oil	2.26 ± 0.29
6	Crude palm oil	4.91 ± 1.01
7	Crude palm oil	2.88 ± 0.58
8	Crude palm oil	3.21 ± 0.52
9	Crude palm oil	4.73 ± 1.51
10	Crude palm oil	8.16 ± 0.93
11	Crude palm oil	3.97 ± 1.18
12	Crude palm oil	3.53 ± 0.62
13	Crude palm oil	1.92 ± 0.33
14	Crude palm oil	4.85 ± 0.81
15	Crude palm oil	2.31 ± 0.48
16	Crude palm oil	2.91 ± 0.32
17	Refined palm oil	0.41 ± 0.12
18	Refined palm oil	1.01 ± 0.15
19	Refined palm oil	0.75 ± 0.12
20	Refined palm oil	0.66 ± 0.09

No	Samples	Total chloride (μg mL^{-1}) (mean ± SD)
Soft oils		
1	Canola oil	0.67 ± 0.06
2	Sunflower oil	0.58 ± 0.02
3	Rice bran oil	0.52 ± 0.01
4	Roasted sesame oil	0.72 ± 0.01
5	High oleic sunflower oil	0.32 ± 0.02
6	Grapeseed oil	0.27 ± 0.03
7	Black seed oil	0.25 ± 0.04
Fruit oils		
8	Extra virgin olive oil	ND
9	Olive oil	0.56 ± 0.08
10	Olive pomace oil	0.99 ± 0.00
11	Palm olein	1.40 ± 0.07
Lauric oils		
12	Coconut oil	0.29 ± 0.04
13	Cold pressed virgin coconut oil	0.45 ± 0.05
14	Palm kernel oil	ND
Nut oils		
15	Walnut oil	2.05 ± 0.14
16	Peanut oil	1.10 ± 0.13
Blended oils		
17	Mixture palm olein and sunflower oil	0.85 ± 0.04
18	Mixture canola oil and corn oil	0.20 ± 0.02
19	Mixture canola oil and sunflower oil	0.44 ± 0.06
20	Mixture canola oil and soybean oil	0.13 ± 0.02

Cross-check exercise for TCC in crude palm oil

Laboratory	TCC (ppm)	Z-Score
MPOB	15.66	-0.08
Lab 1	14.30	-0.66
Lab 2	14.23	-0.69
Lab 3	14.14	-0.72
Lab 4	16.50	0.27

Interpretation of Z-score

Classification	Performance
Z < 2.0	Good / Satisfactory
2.0 < Z < 3.0	Questionable
Z > 3.0	Unsatisfactory

ISO 17025:2017 accreditation of MPOB Food Safety and Quality Laboratory

S/N: 1771

STANDARDS MALAYSIA

Certificate of Accreditation

No: SAMM 461

Accredited since: 24 May 2010

This is to certify that

FOOD SAFETY AND QUALITY LABORATORY
ANALYTICAL AND QUALITY DEVELOPMENT UNIT
PRODUCT DEVELOPMENT AND
ADVISORY SERVICES DIVISION
MALAYSIAN PALM OIL BOARD (MPOB)
KAJANG, SELANGOR
MALAYSIA

Scan the QR Code or visit www.jsm.gov.my/cab-directories for the current scope of accreditation

has been granted accreditation in respect of the scope of accreditation described in the schedule, subject to the terms and conditions governing the *Skim Akreditasi Makmal Malaysia* (SAMM), the Laboratory Accreditation Scheme of Malaysia.

Laboratories accredited under SAMM meet the requirements of MS ISO/IEC 17025. This Malaysian Standard is identical with ISO/IEC 17025 published by the International Organization for Standardization (ISO).

(SHAHARUL SADRI BIN ALWI)
Director General
Department of Standards Malaysia

Date of issue: 19 November 2020
(Issue 2, 19 November 2020 replacement of SAMM 461 dated 18 June 2019)

Issuance of this Certificate is governed by Section 16 Subsections (2) and (3) of Standards of Malaysia Act 1996 (Act 549)

Schedule

Issue date: 25 January 2021
Valid until: 24 May 2022

NO: SAMM 461
(Issue 3, 25 January 2021 replacement of SAMM 461 dated 26 October 2020)

Page: 1 of 1

LABORATORY LOCATION: (PERMANENT LABORATORY)

FOOD SAFETY & QUALITY LABORATORY
ANALYTICAL & QUALITY DEVELOPMENT UNIT
PRODUCT DEVELOPMENT &
ADVISORY SERVICES DIVISION
MALAYSIAN PALM OIL BOARD (MPOB)
NO. 6, PERSIARAN INSTITUSI
BANDAR BARU BANGI
43000 KAJANG
SELANGOR
MALAYSIA

FIELD(S) OF TESTING: **CHEMICAL**

This laboratory has demonstrated its technical competence to operate in accordance with MS ISO/IEC 17025:2017 (ISO/IEC 17025:2017).

This laboratory's fulfillment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and management system requirements that are necessary for it to consistently deliver technically valid test results and calibrations. The management system requirements in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001 (see Joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF TESTING: CHEMICAL

Materials/ Products Tested	Type of Test/ Properties Measured/ Range of Measurement	Standard Test Methods/ Equipment/Techniques
Agriculture Products and Materials Crude Palm Oil	Determination of Paraquat Residue	In-house method PDAS/METHOD-PARAQUAT ANALYSIS/01 based on J. Oil Palm Research, (1999), 11(2):57-62
	Determination of Total Chloride	In-house method PDAS/METHOD-CHLORIDE ANALYSIS/03 based on ASTM D4929-19a
	Determination of Copper (Cu), Phosphorus (P), and Iron (Fe)	In-house method PDAS/METHOD-Cu, P, Fe ANALYSIS/04
Edible Oils and Fats	Determination of 2-and 3-MCPD and Glycidol Fatty Acid Esters	AOCS Method Cd29a-13

Signatory(ies):

1. **Chm. Norizah Halim** **IKM No.: M2957/5708/10**

SKIM AKREDITASI MAKMAL MALAYSIA (SAMM)
LABORATORY ACCREDITATION SCHEME OF MALAYSIA

☑ **Complete transition from ISO 17025:2005**

Paraquat residue

☑ **Expansion of scope**

- Total chlorine content (TCC)
- 2-,3-MCPDE and GE
- Copper, Phosphorus and Iron

Tahniah
MPOB
atas pengiktirafan
SKIM AKREDITASI MAKMAL MALAYSIA (SAMM)
daripada
Jabatan Standard Malaysia
bagi kecekapan sistem pengurusan
Makmal Keselamatan dan Kualiti Makanan
Unit Analitikal dan Pembangunan Kualiti
Bahagian Penyelidikan Pembangunan Produk
dan Khidmat Nasihat (PDAS).
Makmal telah menunjukkan
kecekapan teknikalnya untuk
beroperasi sesuai dengan
MS ISO / IEC 17025: 2017
(ISO / IEC 17025: 2017).

List of commercial laboratories for TCC and 3-MCPDE and GE

No.	Laboratories	Test Services		Contact
		TCC	3-MCPDE and GE	
1.	**INDELAB SDN BHD** 33 & 33-1, Jalan Permai 1C, Taman Pendamaran Permai 42000 Pelabuhan Klang, Selangor	●	●	Mr Cheah Ping Cheong Tel: 03-31656929 / Fax: 03-31676930 Email: admin@indelab.com.my
2.	**INDELAB (EAST) SDN BHD** Block F, Lot 55, MDLD 8341, Layung Industrial Park KM 5 Jalan Tengah Nipah, 91100 Lahad Datu, Sabah	●		Mr Shamsudin Idris Tel: 089-880161 / Fax: Not available Email: indelab.east@gmail.com
3.	**ALS TECHNICHEM SDN BHD** Wisma ALS, No.21, Jalan Astaka U8/84 Bukit Jelutong, 40150 Shah Alam, Selangor	●	●	Ms Lee Yiu Lay Tel: 03-78458257 / Fax: 03-78458258 Email: YiuLay.Lee@alsglobal.com
4.	**BIO SYNERGY LABORATORIES SDN BHD** Lot 1109, Mukim Malau, Daerah Kubang Pasu, 06000 Jitra, Kedah.	●	●	Mr Khoo Hwa Chuan Tel: 04-9161288 / Fax: 04-9173610 Email: hckhoo@biosynergy.com.my
5.	**DYNAKEY LABORATORIES SDN BHD** Lot 5 & 6, 1st Floor, Bandar Sibuga Jaya 2 Batu 8 BQ. 3336, Mail Bag 8, 90000 Sandakan, Sabah	●		Mr Hui Kok Keng Tel: 089-215233 / Fax: 089-226233 Email: dynakey.labs@gmail.com

FOOD SAFETY ISSUES

A NEVER ENDING STORY...

EFSA Report on mineral oil hydrocarbons

European Food Safety Authority

EFSA Journal 2012;10(6):2704

SCIENTIFIC OPINION

Scientific Opinion on Mineral Oil Hydrocarbons in Food[1]

EFSA Panel on Contaminants in the Food Chain (CONTAM)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

Consumers are exposed to a range of mineral oil hydrocarbons (MOH) via food. Mineral oil saturated hydrocarbons (MOSH) consist of linear and branched alkanes, and alkyl-substituted cyclo-alkanes, whilst mineral oil aromatic hydrocarbons (MOAH) include mainly alkyl-substituted polyaromatic hydrocarbons. Products, commonly specified according to their physico-chemical properties, may differ in chemical composition depending on the oil source. Technical grade MOH contain 15 - 35 % MOAH, which is minimised in food grade MOSH (white oils). Major sources of MOH in food are food packaging and additives, processing aids, and lubricants. Estimated MOSH exposure ranged from 0.03 to 0.3 mg/kg b.w. per day, with higher exposure in children. Specific production practices of bread and grains may provide additional MOSH exposure. Except for white oils, exposure to MOAH is about 20 % of that of MOSH. Absorption of alkanes with carbon number above C_{35} is negligible. Branched and cyclic alkanes are less efficiently oxidised than n-alkanes. MOSH from C_{16} to C_{35} may accumulate and cause microgranulomas in several tissues including lymph nodes, spleen and liver. Hepatic microgranulomas associated with inflammation in Fischer 344 rats were considered the critical effect. The no-observed-adverse-effect level for induction of liver microgranulomas by the most potent MOSH, 19 mg/kg b.w. per day, was used as a Reference Point for calculating margins of exposure (MOEs) for background MOSH exposure. MOEs ranged from 59 to 680. Hence, background exposure to MOSH via food in Europe was considered of potential concern. Foodborne MOAH with three or more, non- or simple-alkylated, aromatic rings may be mutagenic and carcinogenic, and therefore of potential concern. Revision of the existing acceptable daily intake for some food grade MOSH is warranted on the basis of new toxicological information.

© European Food Safety Authority, 2012

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[1] On request from the European Commission, Question No EFSA-Q-2010-00170, adopted on 3 May 2012.

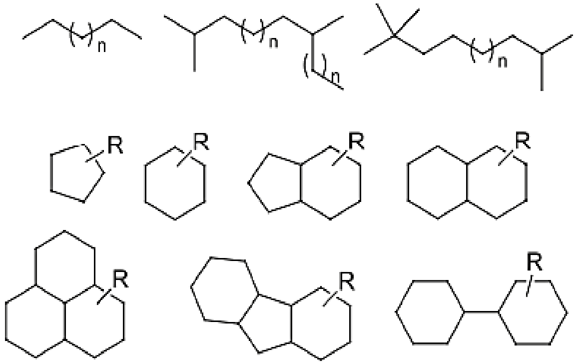
[2] Panel members: Jan Alexander, Diane Benford, Alan Raymond Boobis, Sandra Ceccatelli, Bruce Cottrill, Jean-Pierre Cravedi, Alessandro Di Domenico, Daniel Doerge, Eugenia Dogliotti, Lutz Edler, Peter Farmer, Metka Filipič, Johanna Fink-Gremmels, Peter Fürst, Thierry Guérin, Helle Katrine Knutsen, Miroslav Machala, Antonio Mutti, Martin Rose, Josef Rudolf Schlatter and Rolaf van Leeuwen. Correspondence: contam@efsa.europa.eu

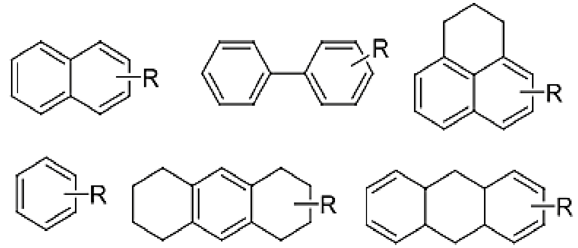
[3] Acknowledgement: The CONTAM Panel wishes to thank the members of the CONTAM Working Group on Mineral hydrocarbons in Food for the preparation of this opinion: Jan Alexander, Jan Beens, Alan Boobis, Jean-Pierre Cravedi, Koni Grob, Thierry Guérin, Unni Cecilie Nygaard, Karla Pfaff, Shirley Price, and Paul Tobback. For the support on the sections relevant to the occurrence of mineral oil hydrocarbons in food contact materials and exposure from foods packed in recycled paper, the CONTAM Panel wishes to thank the EFSA Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids (CEF Panel): Ulla Beckman Sundh, Mona-Lise Binderup, Leon Brimer, Laurence Castle, Karl-Heinz Engel, Roland Franz, Nathalie Gontard, Rainer Gürtler, Trine Husøy, Klaus-Dieter Jany, Catherine Leclercq, Jean-Claude Lhuguenot, Wim Mennes, Maria Rosaria Milana, Iona Pratt, Kettil Svensson, Fidel Toldrá, Detlef Wölfle, and the members of the CEF Working Group on Food Contact Materials: Mona-Lise Binderup, Laurence Castle, Riccardo Crebelli, Roland Franz, Nathalie Gontard, Eugenia Lampi, Jean-Claude Lhuguenot, Maria Rosaria Milana, Karla Pfaff, Maria de Fátima Poças, Philippe Saillard, Kettil Svensson and Detlef Wölfle. Both Panels thank EFSA's staff members Davide Arcella, Marco Binaglia, Gina Cioacata, Dimitrios Spyropoulos, Natalie Thatcher and Francesco Vernazza, for the support provided to this EFSA scientific output.

Suggested citation: EFSA Panel on Contaminants in the Food Chain (CONTAM); Scientific Opinion on Mineral Oil Hydrocarbons in Food. EFSA Journal 2012;10(6):2704. [185 pp.] doi:10.2903/j.efsa.2012.2704. Available online: www.efsa.europa.eu/efsajournal

© European Food Safety Authority, 2012

EFSA Scientific Opinion on mineral oil hydrocarbons in food (2012)





- ☐ Saturated hydrocarbons (MOSH)
- ☐ Straight or branched alkanes and alkylated cycloalkanes

- ☐ Aromatic hydrocarbons (MOAH)
- ☐ Aromatic hydrocarbons including alkyl-substitution

"...**An Scientific Opinion** published on 2012 from the CONTAM Panel of EFSA concluded that the present exposure to **MOSH** ranging from **0.03 to 0.3 mg kg^{-1} bw per day** is of "**potential concern**" especially to children. It was reported that MOSH could be **accumulated** in **tissues, lymph nodes, spleen and liver, and can cause microgranulomas** (Brühl, 2016) while, **MOAH** considered as **possible carcinogenic** and **mutagenic substances** (Weber et al., 2018)..."

First report on edible oil containing mineral oil hydrocarbons (MOH) in 2018

Sunflower oil adulterated with MOH from unidentified source was shipped from Ukraine to EU

Incidences of mineral oil hydrocarbons

12 July 2016

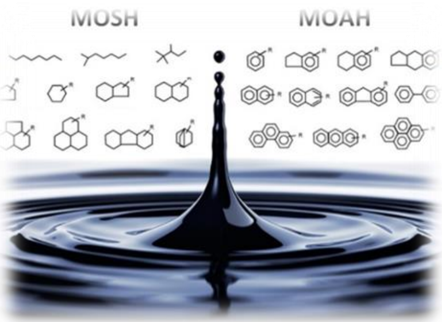
Selected Ferrero, Lindt and Rübezahl chocolate purchased in Germany have been found to contain mineral oils

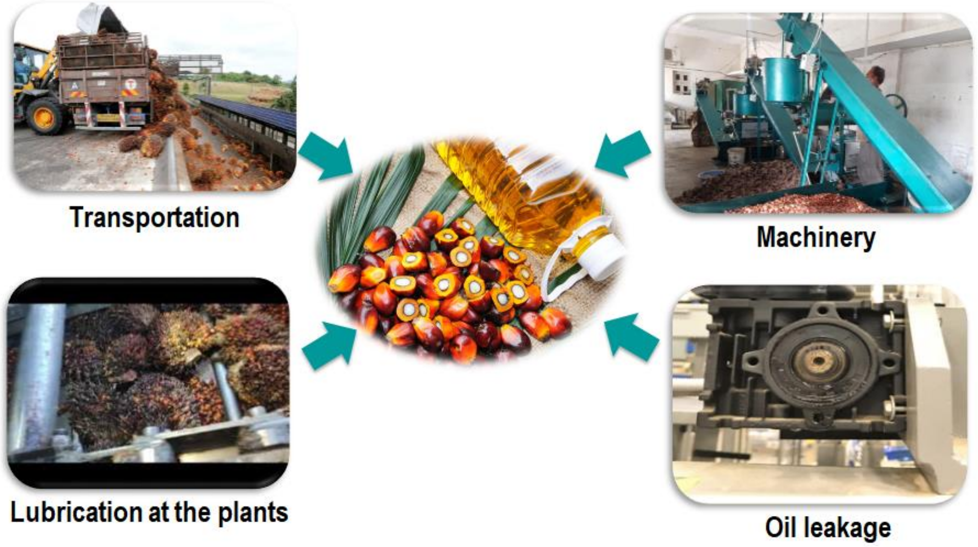
24 October 2019

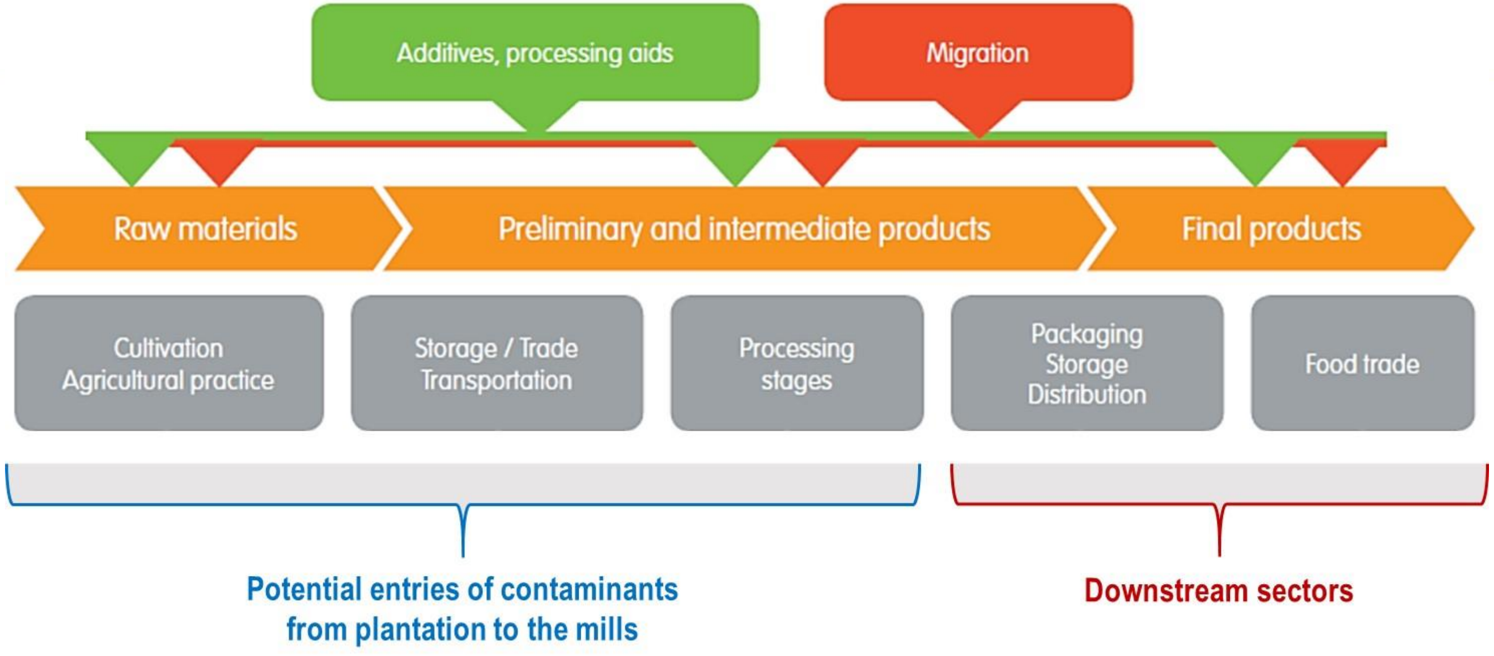
Suspected carcinogenic mineral oil residues in baby milk products, *i.e.* Nestlé, Danone, Novalac, Neolac, Hero Baby and Nutrilon, on sale in France, the Netherlands and Germany

foodwatch

Possible routes of mineral oil hydrocarbons at the oil palm supply chain







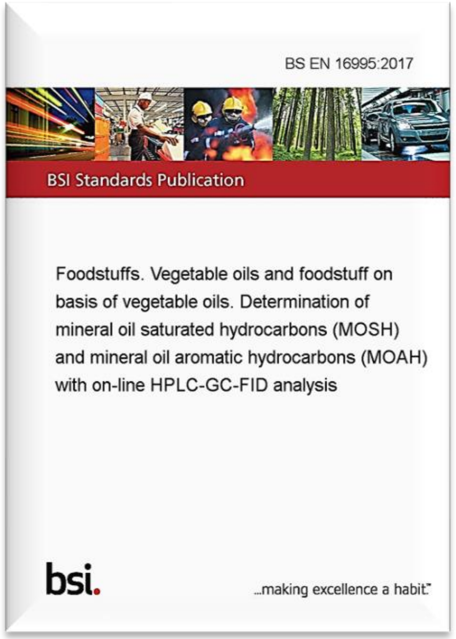
Potential entries of contaminants from plantation to the mills

Downstream sectors

	Max level (applicable 01.07.2020)		
	Palm oils and Coconut oils	Other vegetable oils and Animal Fats including Fish oils	Infant Grade ingredients ****ALARA**
MOSH	< 20 mg/kg oil	13 mg/kg oil	< 10 mg/kg oil
MOAH	< 2 mg/kg oil	<LOQ mg/kg oil*	< 2 mg/kg oil

ALARA - As low as reasonably achievable

MOSH and MOAH official method and guidance document



BS EN 16995:2017

BSI Standards Publication

Foodstuffs. Vegetable oils and foodstuff on basis of vegetable oils. Determination of mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH) with on-line HPLC-GC-FID analysis

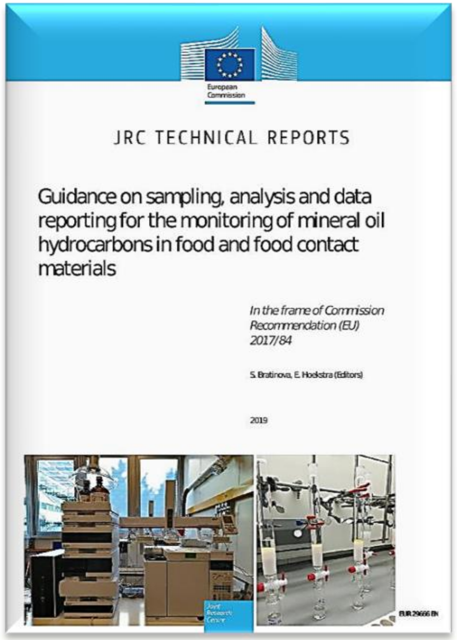
bsi.

...making excellence a habit.™

- ☐ EU standard BS EN 16955 for MOH published in 2017
- ☐ Using online HPLC-GC-FID
- ☐ LOQ of 10 mg kg^{-1}
- ☐ Standard revision is aiming to lower LOQ to 1 mg kg^{-1}

On-line HPLC-GC-FID

- ☐ JRC Guidelines published in 2019
- ☐ EUR 29666 EN Technical Report including method of analysis and performance



European Commission

JRC TECHNICAL REPORTS

Guidance on sampling, analysis and data reporting for the monitoring of mineral oil hydrocarbons in food and food contact materials

In the frame of Commission Recommendation (EU) 2017/84

S. Bratinova, E. Hoekstra (Editors)

2019

EUR 29666 EN

Extraction
- Solvent extraction
- Mixed-solvent Extr.
- Saponification

Clean-up
- Enrichment
- Si-Alox column
- Epoxidation

Isolation & Quantification

On-line LC-GC-FID

LC: MOSH & MOAH

GC-FID: determination

Current effort: Method establishment and harmonisation

"Utilisation of non-integrated and off-line instrument system affecting method performance..."

"Inconsistent test proficiency between the established international laboratories..."

"Tedious and time consuming especially for CPO and secondary oils..."

Sample Name	SGS, Germany		ITERG, France		Kirchhoff Institute, Germany	
	Sum MOSH	Sum MOAH	Sum MOSH	Sum MOAH	Sum MOSH	Sum MOAH
Production oil (CPO)	5.1 ppm	< 1.0 ppm	< 10.0 ppm	< 2.0 ppm	9.0 ppm	< 1.0 ppm
Sterilizer condensate oil	18.5 ppm	< 1.0 ppm	20.0 ppm	3.0 ppm	25.6 ppm	< 1.0 ppm
Undiluted crude oil	7.2 ppm	< 1.0 ppm	< 10.0 ppm	2.0 ppm	5.1 ppm	< 1.0 ppm
Price / sample (Euro) in 2019	230.00*		300.00*		284.00*	

Cross-check exercise for MOSH in oil matrices

Sample code	MPOB*	Local Lab*	IKB**
CPO 102	27.23	9.22	18.90
CPO 107	18.26	8.86	13.10
CPO 108	22.49	12.94	19.00

* online LC-GC-FID system with manual sample preparation
** online LC-GC-FID system and automated sample preparation setup

- ☐ Results from MPOB are 40% higher compared to IKB due to different instrument configuration and manual sample preparation
- ☐ High interferences were observed in the chromatogram possibility due to the presence of plastic materials (PE, PP, HDPE)
- ☐ Packing migration could be the major contribution of oligomers from polyethylene or polypropylene materials detected as MOSH fractions namely poly-olefinic oligomeric saturated hydrocarbons (POSH) and poly-alpha olefins (PAO)

MOAH detection is still in progress due to challenge on saponification and epoxidation for sample preparation

Sample code	MPOB*	Proof ACS**
RBDPO Blank	40.26	14.9
RBDPO Spiked	51.93	15.2
Rapeseed oil Blank	22.12	1.71
Rapeseed oil Spiked	36.22	11 to 20

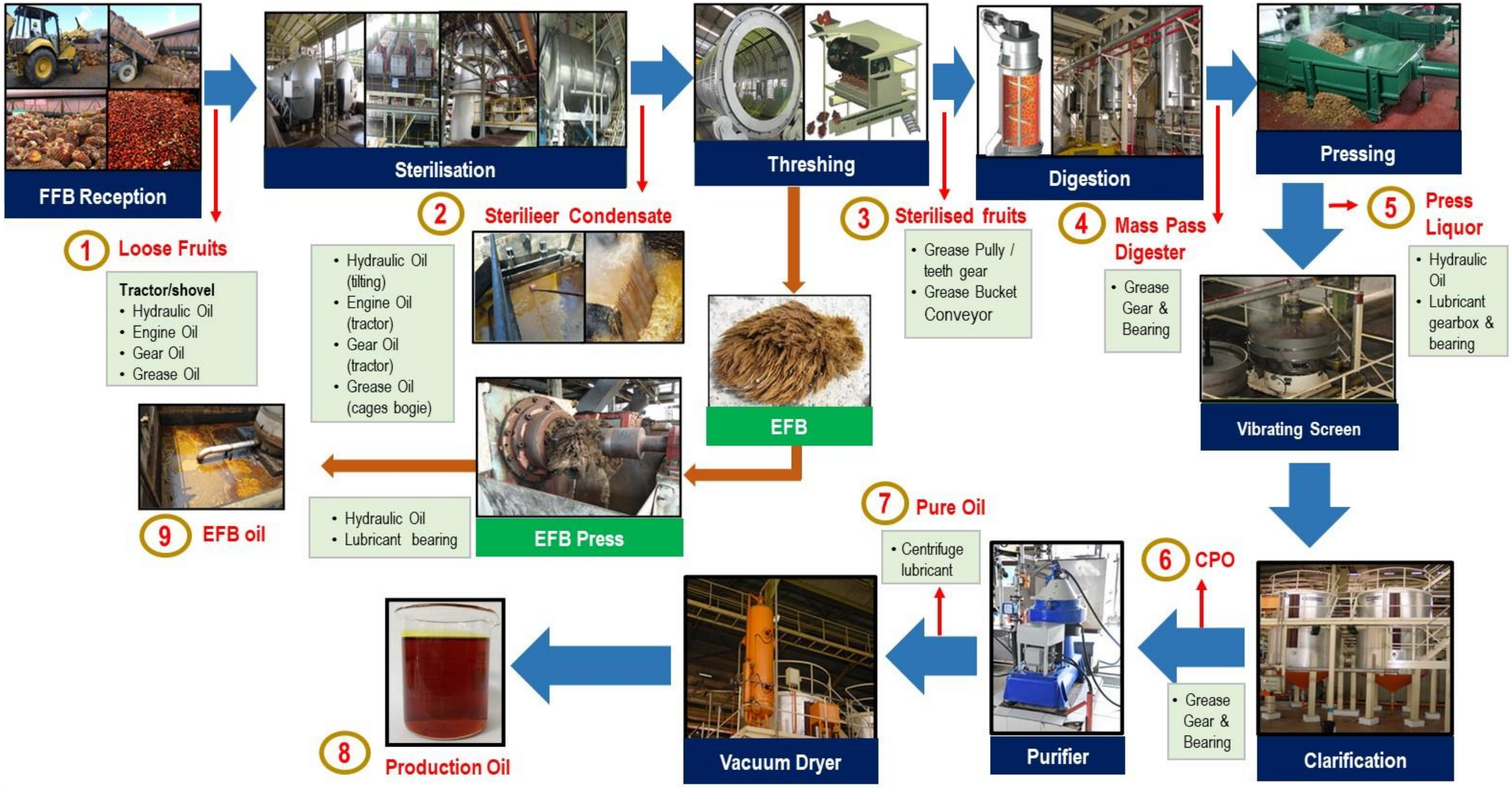
* online LC-GC-FID system with manual sample preparation
** online LC-GC-FID system and automated sample preparation

- ☐ Results from MPOB is significantly higher compared to MOSH value from Prof ACSpossibility due to high POSH interference
- ☐ Baking all laboratory glassware used in the sample preparation slightly reduce the interference
- ☐ Optimisation of sample preparation protocol is still on-going to minimise the occurrence of POSH and POA from plastic

Critical control points for MOSH and MOAH at the palm oil mill

9

Critical Control Points



FFB Reception

① Loose Fruits

Tractor/shovel
- Hydraulic Oil
- Engine Oil
- Gear Oil
- Grease Oil

Sterilisation

② Sterilieer Condensate

- Hydraulic Oil (tilting)
- Engine Oil (tractor)
- Gear Oil (tractor)
- Grease Oil (cages bogie)

Threshing

③ Sterilised fruits

- Grease Pully / teeth gear
- Grease Bucket Conveyor

Digestion

④ Mass Pass Digester

- Grease Gear & Bearing

Pressing

⑤ Press Liquor

- Hydraulic Oil
- Lubricant gearbox & bearing

Vibrating Screen

Clarification

⑥ CPO

- Grease Gear & Bearing

Purifier

⑦ Pure Oil

- Centrifuge lubricant

Vacuum Dryer

⑧ Production Oil

EFB

EFB Press

- Hydraulic Oil
- Lubricant bearing

⑨ EFB oil

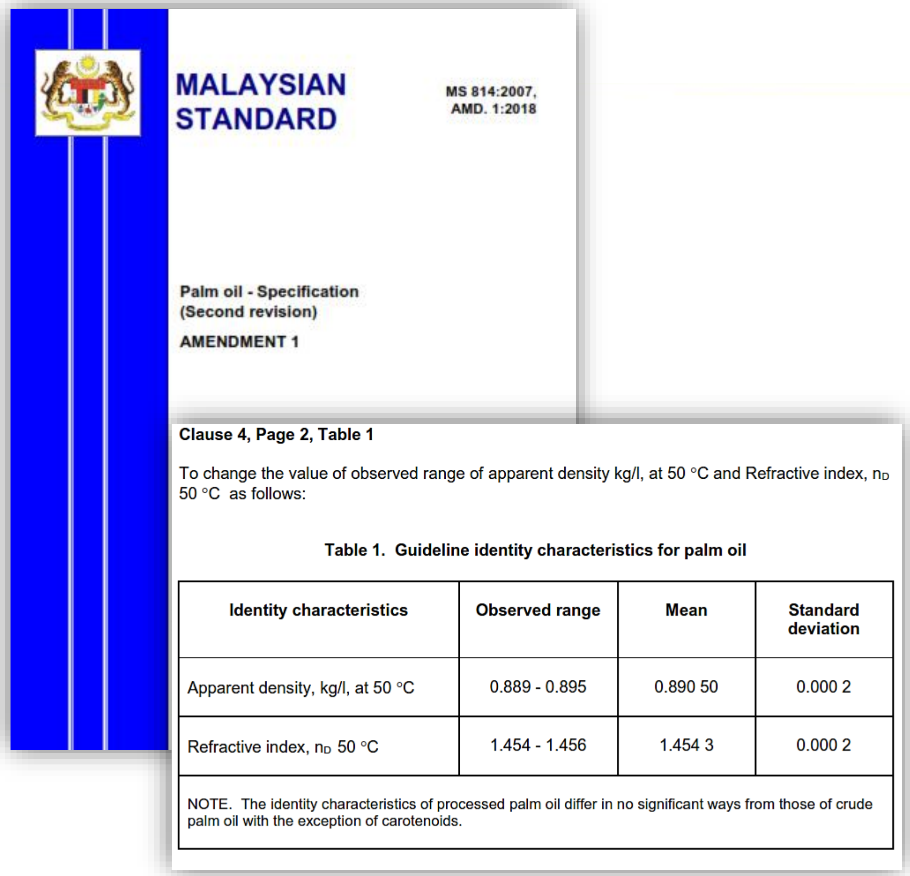
PALM OIL QUALITY

Standard development and specification enhancement

Involvement in Codex Committee on Fats and Oils (CCFO)

26th Session of the Codex Committee on Fats and Oils (CCFO) from 25th February 2019 to 1st March 2019

- MPOB is responsible as the Secretariat of National Codex Sub-Committee on Fats and Oils (CCFO)
- Amendment of refractive index and apparent density of palm superolein at 40°C **successfully adopted** into the Codex Standard for Named Vegetable Oil (CODEX STAN 210:1999)
- Replacement of acid value with free fatty acid for virgin palm oil and inclusion of free fatty acids for crude palm kernel oil **successfully adopted** into the Codex Standard for Named Vegetable Oil (CODEX STAN 210:1999)



MALAYSIAN STANDARD

MS 814:2007,
AMD. 1:2018

Palm oil - Specification
(Second revision)

AMENDMENT 1

Clause 4, Page 2, Table 1

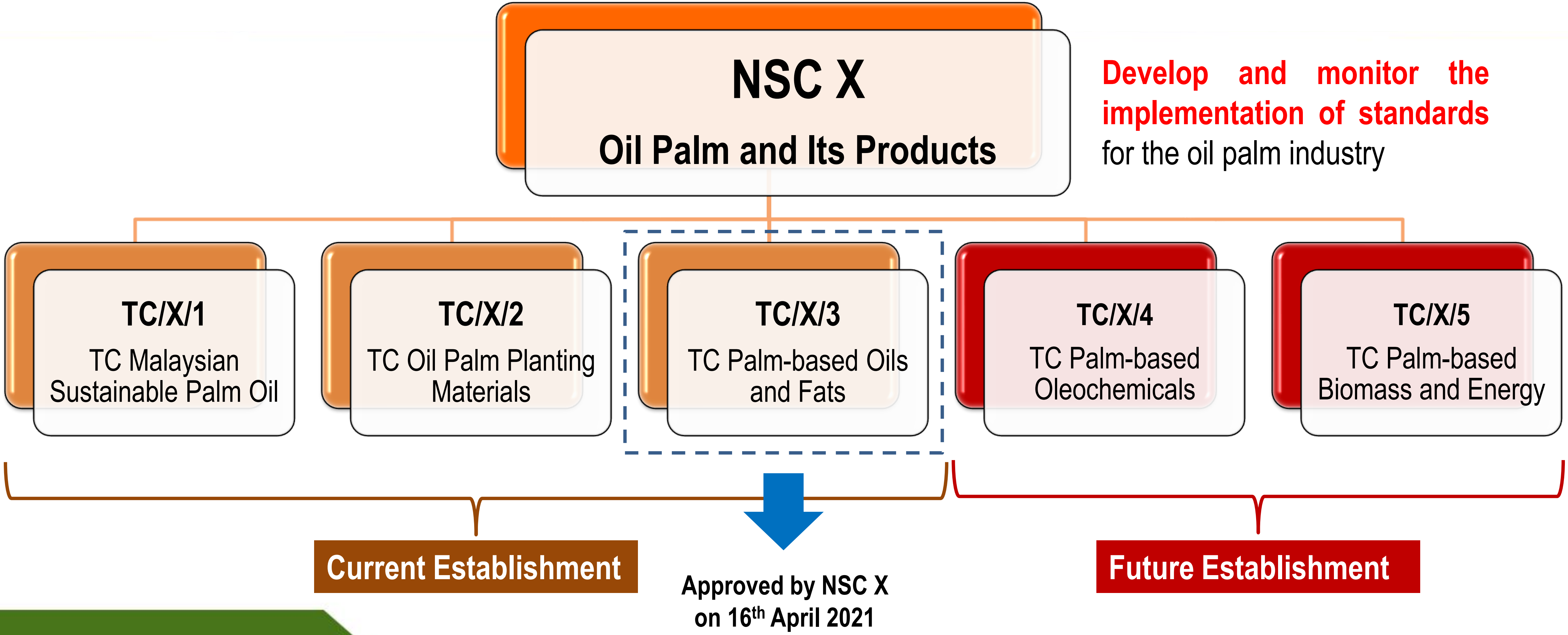
To change the value of observed range of apparent density kg/l, at 50 °C and Refractive index, n_D 50 °C as follows:

Table 1. Guideline identity characteristics for palm oil

Identity characteristics	Observed range	Mean	Standard deviation
Apparent density, kg/l, at 50 °C	0.889 - 0.895	0.890 50	0.000 2
Refractive index, n_D 50 °C	1.454 - 1.456	1.454 3	0.000 2
NOTE. The identity characteristics of processed palm oil differ in no significant ways from those of crude palm oil with the exception of carotenoids.			

Amendment of MS 814:2007 AMD. 1:2018 Palm oil specification (2nd revision)

Reviving Malaysian Standards related to palm oil safety and quality



NSC X

Oil Palm and Its Products

Develop and monitor the implementation of standards for the oil palm industry

TC/X/1
TC Malaysian Sustainable Palm Oil

TC/X/2
TC Oil Palm Planting Materials

TC/X/3
TC Palm-based Oils and Fats

TC/X/4
TC Palm-based Oleochemicals

TC/X/5
TC Palm-based Biomass and Energy

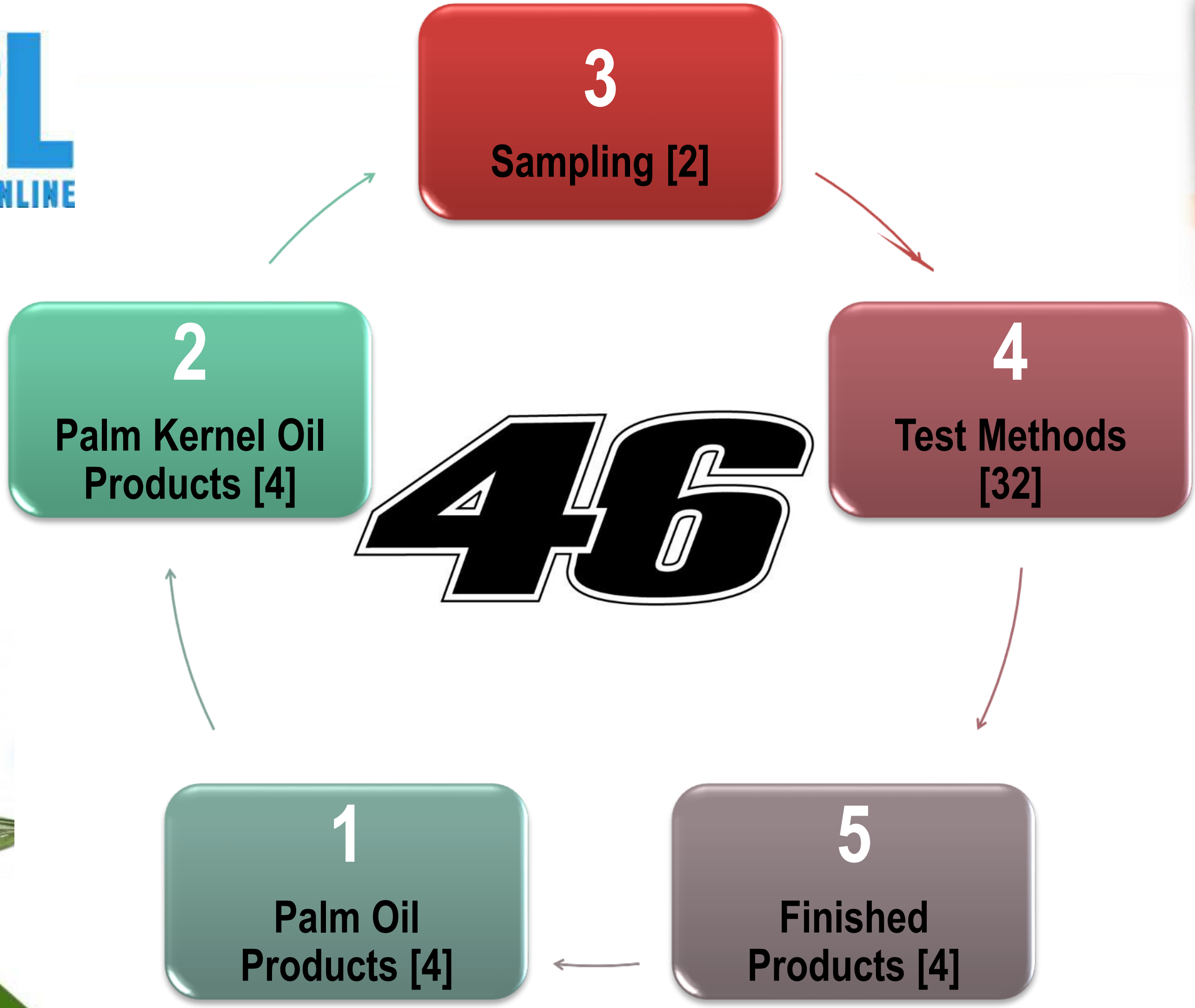
Current Establishment

Approved by NSC X
on 16th April 2021

Future Establishment

Current MS documents related to palm oil and its products

mySOL
MALAYSIAN STANDARDS ONLINE



3
Sampling [2]

2
Palm Kernel Oil Products [4]

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4
Test Methods [32]

1
Palm Oil Products [4]

5
Finished Products [4]

MALAYSIAN
STANDARD

MS 814:2007,
AMD. 1:2018

Palm oil - Specification
(Second revision)

AMENDMENT 1

ICS: 67.200.10

Descriptors: palm oil, specification

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DEPARTMENT OF STANDARDS MALAYSIA

Roadmap on Malaysian Standard development and improvement

READY TO EXECUTE

Amendment of MS 1762:2002 Palm superolein specification

Amendment of MS 815:2007 Palm stearin specification

my SOL MALAYSIAN STANDARDS ONLINE

CURRENT SURVEY AND ASSESSMENT

Revision of MS 814:2007 Palm oil specification

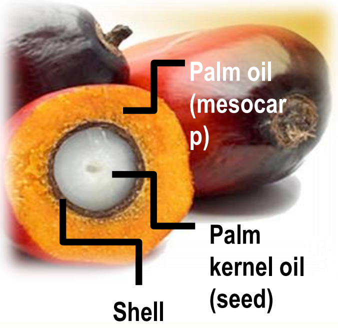
Development of New MS for secondary oils

FUTURE EFFORTS FOR NEW MS

Total chlorine content method

Red palm oil specification

Palm phenolics specification



CURRENT MS FOR REVIEW

Priortise of selective MS documents for review

Periodic review of MS documents

Way Forward Programme

Type and source of secondary oils

STERILISATION STATION


FFB loaded into the steriliser


Steriliser condensate

PRESSING STATION

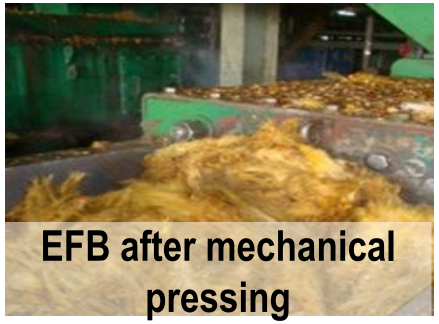

Mesocarp pressed fibre


Dried mesocarp pressed fibre from cyclone


Palm pressed fibre oil (PPFO)

THRESHING STATION


Empty fruit bunches (EFB)


EFB after mechanical pressing


EFB liquor

Identity characteristics of secondary oils

Parameters	EFBO (n = 21)		PPFO (n = 16)		SCO (n = 19)	
	Average	Range	Average	Range	Average	Range
FFA (% as palmitic)	9.43 ± 3.62	3.99 to 20.85	6.84 ± 2.06	4.55 to 12.92	14.78 ± 4.28	11.0 to 19.43
Moisture (%)	0.33 ± 0.12	0.13 to 0.51	0.22 ± 0.07	0.14 to 0.36	0.32 ± 0.01	0.32 to 0.33
Impurities (%)	0.02 ± 0.01	0 to 0.05	0.01 ± 0.01	0 to 0.04	0.06 ± 0.06	0.01 to 0.20
p-AnV	2.68 ± 1.69	0.24 to 6.63	10.65 ± 1.96	8.51 to 13.13	5.90 ± 2.57	2.70 to 8.60
PV (meq O_2/kg)	0.36 ± 0.31	0.1 to 0.57	2.24 ± 1.72	0.35 to 6.24	1.60 ± 0.67	0.66 to 2.56
Lovibond colour, 1” (Red)	25.2 ± 11.1	12.3 to 51.0	14.0 ± 6.5	10 to 28.5	11.1	11.1
Carotenes (ppm)	526 ± 35	471 to 575	1027 ± 334	560 to 1560	429 ± 51	399 to 487
DOBI	1.58 ± 0.45	1.28 to 2.43	1.42 ± 0.37	0.94 to 2.09	1.49 ± 0.31	1.39 to 1.84
Fe (ppm)	5.49 ± 5.33	0.3 to 21.6	80.64 ± 32.08	41.15 to 142.5	22.39 ± 22.05	3.69 to 86.24
P (ppm)	18.31 ± 13.91	1.4 to 55.2	1249.36 ± 356.30	910 to 2144.5	26.30 ± 16.55	6.43 to 51.10
Cu (ppm)	ND	ND	0.54 ± 0.23	0.176 to 0.752	ND	ND
Total chlorine content (ppm)	4.77 ± 2.65	0.6 to 8.8	174.25 ± 52.67	89.38 to 257.65	3.79 ± 3.46	1.35 to 6.24

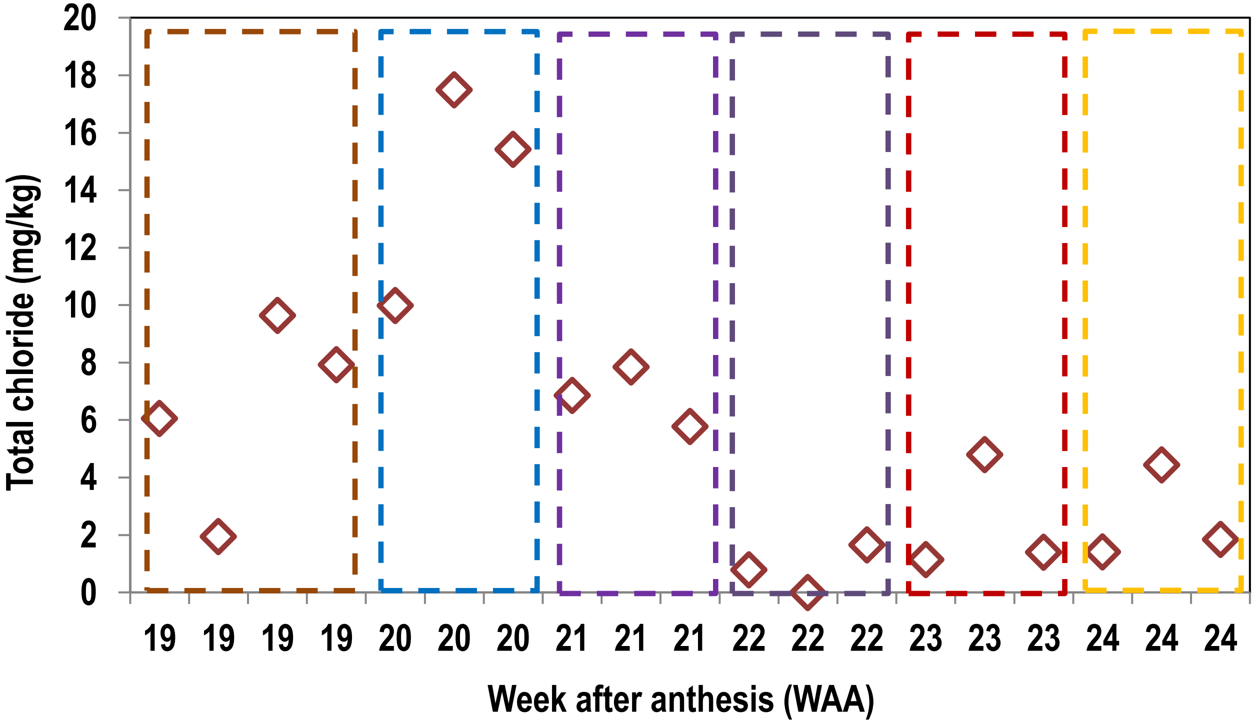
EFBO - Empty fruit bunches oil; PPFO - Palm-pressed fibre oil; SCO - Steriliser condensate oil

Identity characteristics of secondary oils (Continued)

Parameter	EFBO (n = 21)		PPFO (n = 16)		SCO (n = 19)	
	Average	Range	Average	Range	Average	Range
AD (kg/l), at 50°C	0.88892 ± 0.00029	0.88834 to 0.88934	0.88975 ± 0.00199	0.89677 to 0.90172	NA	NA
RI (n_D), at 50°C	1.45357 ± 0.00113	1.45095 to 1.45469	1.45480 ± 0.00010	1.45320 to 1.45758	1.45289 ± 0.00101	1.45223 to 1.45405
IV (g I_2/100g)	52 ± 2	49 to 56	51 ± 4	39 to 58	52 ± 1	48.57 to 53.85
SMP (°C)	34.5 ± 2.7	28.6 to 39.6	33.4 ± 5.1	24.1 to 39.3	35.4 ± 1.6	32.4 to 38.1
SV (mg KOH/g oil)	206 ± 5	199 to 215	203 ± 2	200 to 206	203 ± 3	199 to 207
FAC (wt % as methyl esters)						
C8:0	ND	ND	0.30 ± 0.20	0.10 to 0.50	ND	ND
C10: 0	0.20 ± 0.10	0.10 to 0.35	0.20 ± 0.17	0.10 to 0.50	ND	ND
C12: 0	0.25 ± 0.15	0.10 to 0.55	1.30 ± 1.19	0.10 to 7.00	0.20 ± 0.12	0.10 to 0.40
C14: 0	1.10 ± 0.07	1.00 to 1.20	1.80 ± 0.75	1.10 to 3.30	1.05 ± 0.04	1.00 to 1.10
C16: 0	43.12 ± 2.00	37.75 to 46.75	41.20 ± 2.32	35.30 to 44.0	44.0 ± 1.13	42.50 to 45.20
C16: 1	0.20 ± 0.07	0.10 to 0.40	0.20 ± 0.07	0.10 to 0.40	0.17 ± 0.03	0.15 to 0.20
C18: 0	4.37 ± 0.57	3.90 to 6.30	4.30 ± 0.67	3.60 to 6.10	4.43 ± 0.35	4.00 to 4.95
C18: 1	38.79 ± 1.73	36.10 to 41.50	38.40 ± 1.37	36.00 to 39.90	38.56 ± 0.54	37.80 to 39.45
C18: 2	10.08 ± 0.61	9.00 to 11.70	10.30 ± 1.01	8.70 to 12.60	10.14 ± 0.40	9.65 to 10.55
C18: 3	0.33 ± 0.07	0.20 to 0.50	0.40 ± 0.15	0.2 to 0.7	0.42 ± 0.07	0.35 to 0.55
C20: 0	0.42 ± 0.09	0.3 to 0.6	0.43 ± 0.11	0.3 to 0.7	0.38 ± 0.08	0.30 to 0.50
C20: 1	0.24 ± 0.05	0.2 to 0.35	0.31 ± 0.15	0.1 to 0.7	0.20 ± 0.04	0.15 to 0.25
C22: 0	ND	ND	0.24 ± 0.19	0.1 to 0.5	ND	ND
C22: 1	ND	ND	0.23 ± 0.05	0.2 to 0.3	ND	ND

"…Data for the establishment of new Malaysian Standard (MS) document for secondary, recovered or technical grade oils from palm oil…"

Preliminary study on the effect of fruit ripeness on total chloride



Unripe (Less than 20 WAA)

Underripe (20 to 21 WAA)

Ripe (22 to 23 WAA)

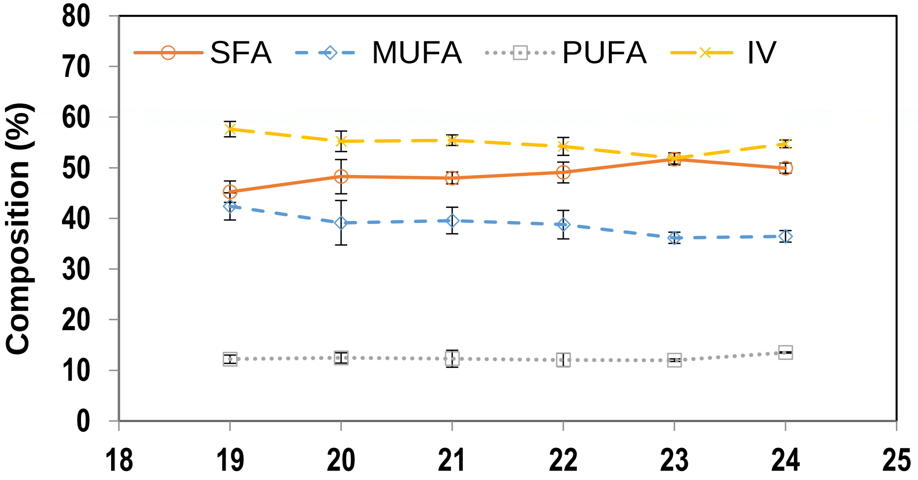
Overripe (Exceeds 24 WAA)

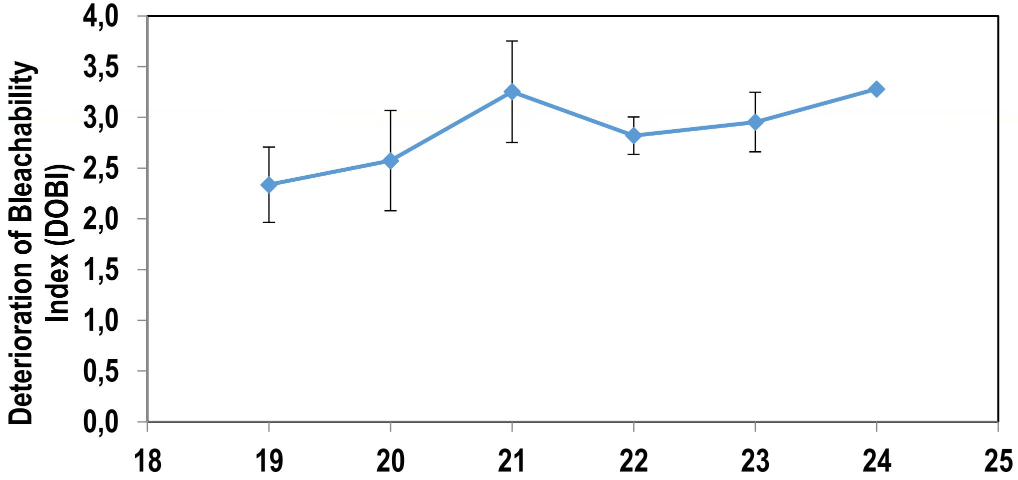
"...Total chloride content in CPO is affected by FFB than degree of ripeness"...

*Note: WAA: weeks after anthesis)

Preliminary study on the effect of fruit ripeness on quality parameters

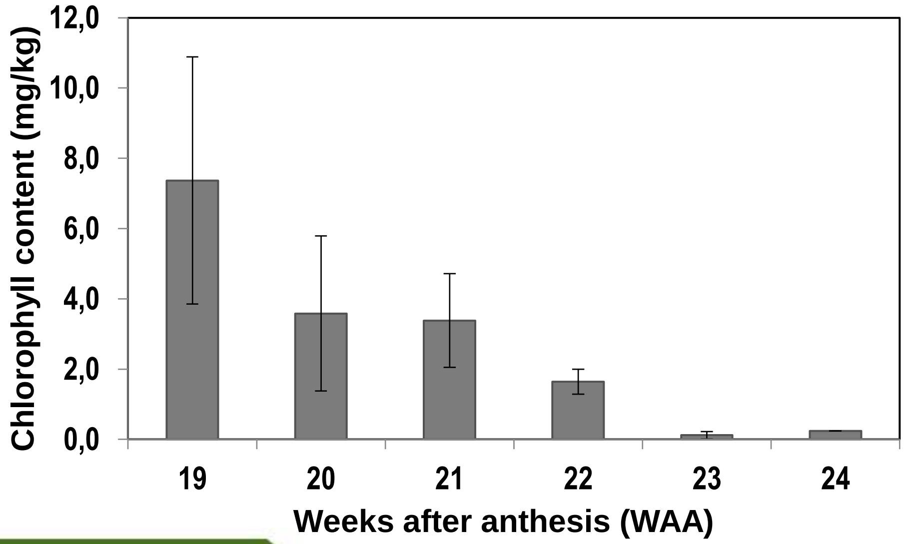
FAC and IV

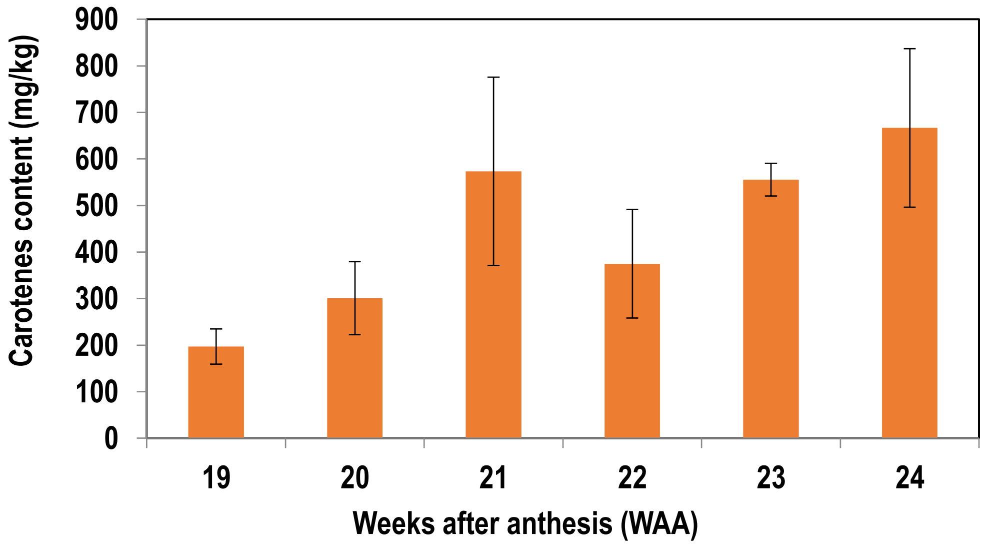




DOBI

Chlorophyll





Carotenes

Take home message

Mitigation of 3-MCPDE and GE could be accomplished using several technologies at both mill and refinery sectors

MOSH and MOAH are the latest food safety concern which require commitment from the palm oil industry

Strengthening the quality and specification of palm oil through standards to reflect our assurance in food safety

Food safety and quality are the next **TRADE BARRIER** if we decide to do nothing

See You at

PIPOC 2023

MPOB INTERNATIONAL PALM OIL CONGRESS AND EXHIBITION

7-9 NOVEMBER

KUALA LUMPUR CONVENTION CENTRE,
KUALA LUMPUR, MALAYSIA

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