



IV CONGRESO PALMERO CPAL 2023

SANTO DOMINGO DEL CERRO

LA ANTIGUA GUATEMALA - 2023





CPO Washing to remove chlorine, a precursor to 3-MCPD

Presented by

Hong, Boon Kheng

Global Sales Manager

CPO & Latex application, Food & Water Division

Alfa Laval (Malaysia)



CPO Washing to remove chlorine, a precursor to 3-MCPD

3-MCPD has been getting a lot of attention in recent years in the edible oil industry.

In fact, discussion about it has been around for decades.

In 1978, 3-MCPD and its esters were identified as food contaminants in hydrolyzed vegetable proteins (HVPs.)

Since then, efforts have been made to identify in other foods, including edible oils, that may contain these contaminants.



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In 2013, the European Food Safety Authority (EFSA) identified margarine, preserved meats, bread and vegetable oil as major sources of 3-MCPD and its esters.

Extensive studies about the potentially harmful effects of this trace compounds in the human body led to increased regulation in 2018 about the maximum content of these contaminants in food.

As such, it is important to understand what 3-MCPD and its esters is, and how to reduce its formation in edible oil refining.



CPO Washing to remove chlorine, a precursor to 3-MCPD

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

(Text with EEA relevance)

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'Section 4: 3-monochloropropanediol (3-MCPD), 3-MCPD fatty acid esters and glycidyl fatty acid esters

	Foodstuffs (*)	Maximum level (µg/kg)
4.3	Sum of 3-monochloropropanediol (3-MCPD) and 3-MCPD fatty acid esters, expressed as 3-MCPD (****)	
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 4.3.2 and of virgin olive oils (*): — 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,	1 250
	— 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, - Including refined Palm Oil	2 500
	— mixtures of oils and fats from the two abovementioned categories.	— (*****)



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HAS ADOPTED THIS REGULATION:

Article 1

The Annex to Regulation (EC) No 1881/2006 is amended in accordance with the Annex to this Regulation.

Article 2

Fish oils and oils from other marine organisms referred to in point 4.2.1 and 4.2.2 of the Annex to Regulation (EC) No 1881/2006 and young child formula referred to in point 4.2.3 and 4.2.4 of that Annex that were lawfully placed on the market before 1 January 2021 may continue to be marketed until 30 June 2021.

Foodstuffs listed under point 4.3 of the Annex to Regulation (EC) No 1881/2006 that were lawfully placed on the market before 1 January 2021 may continue to be marketed until their date of minimum durability or use-by date.



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3-MCPDE found present in Refined Palm Oil is not found in Crude Palm Oil.

But the contaminant that is the pre-cursor to the formation of 3-MCPDE, which is Chloride are found in Crude Palm Oil.

To mitigate the formation of 3-MCPDE, this contaminant must be reduced or removed from the Crude Palm Oil before refining.



CPO Washing to remove chlorine, a precursor to 3-MCPD

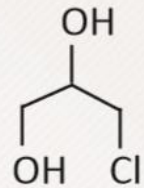
Studies carried out on animals showed that fatty acid esters of 3-MCPD and free 3-MCPD affects kidney and male reproductive systems.

International Agency for Research on Cancer of World Health Organization has classified 3-MCPD as Group 2B, “possible carcinogenic to humans”.

Source: EFSA Journal 2018;16(1):5083 - Update of the risk assessment on 3-monochloropropane diol and its fatty acid esters

Source: https://web.archive.org/web/20170610015529/http://monographs.iarc.fr/ENG/Classification/latest_classif.php

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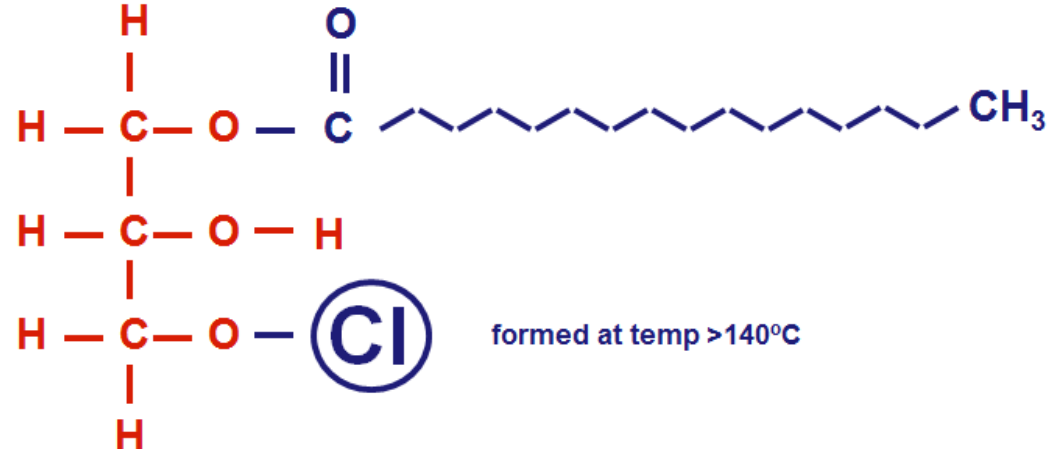
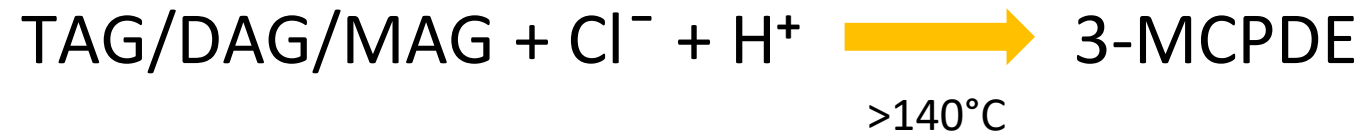


3-MCPD

3-Monochloropropane-1,2-diol

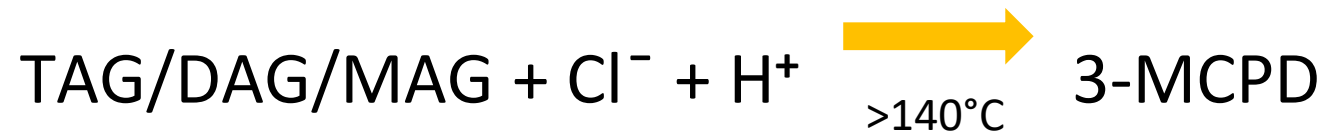
: Formula = $\text{HOCH}_2\text{CH}(\text{OH})\text{CH}_2\text{Cl}$

CPO Washing to remove chlorine, a precursor to 3-MCPD



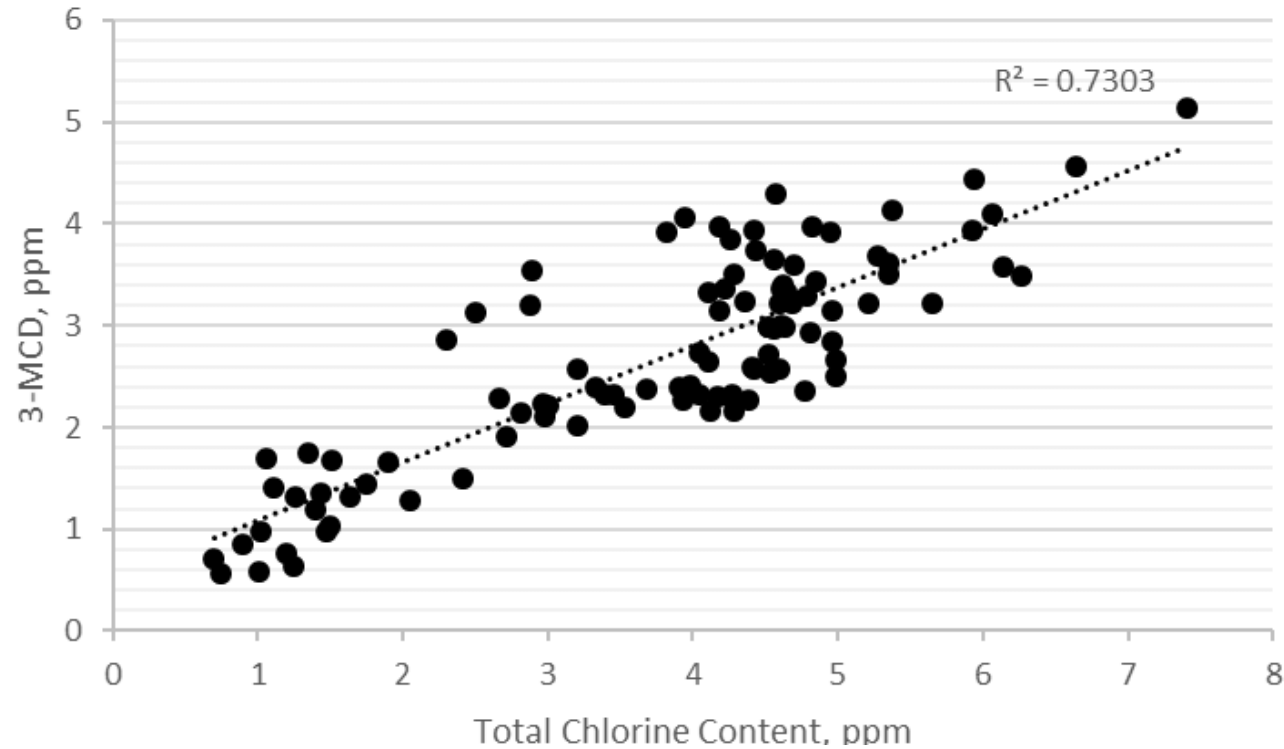
CPO Washing to remove chlorine, a precursor to 3-MCPD

3MCPD is formed in heat-processed fatty foods from glycerol or acyl glycerides in the presence of chloride ions. The formation of 3MCPDE is an irreversible process. Once formed, there is no known method by which it can be removed.



CPO Washing to remove chlorine, a precursor to 3-MCPD

Effect of total chloride content in Crude Palm Oil on formation of 3-MCPD in Refined Palm oil



Source: Natural Organochlorines as Precursors of 3-Monochloropropanediol Esters in Vegetable Oils - J. Agric. Food Chem. 2018, 66, 999–1007

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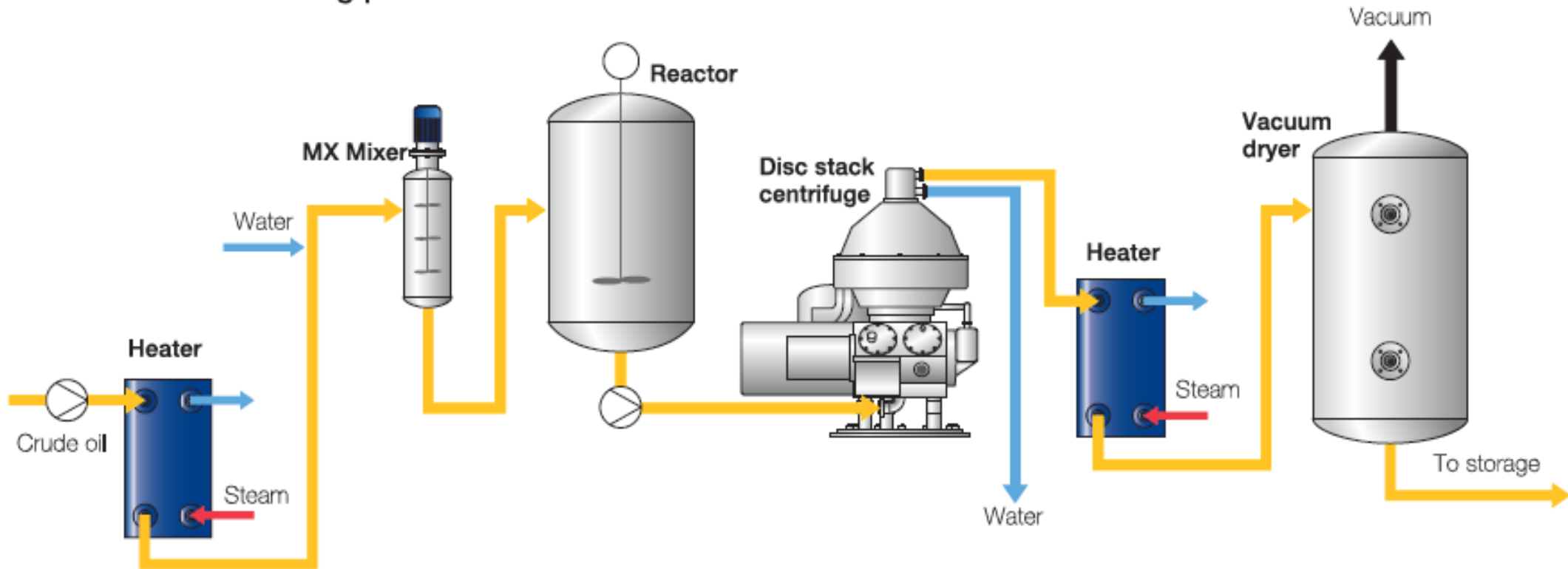
Level of Chloride content against 3-MCPD content in Palm oil products

Sample	Average (ppm)	Range (ppm)	RSD %
Crude Palm Oil	7.293 ± 5.988	2.623 to 15.584	82.103
RBD Palm Oil	2.460 ± 0.912	1.085 to 3.512	37.076
RBD Palm Stearin	1.892 ± 1.063	0.147 to 3.104	56.201
RBD Palm Olein	2.301 ± 1.115	1.213 to 3.721	48.479

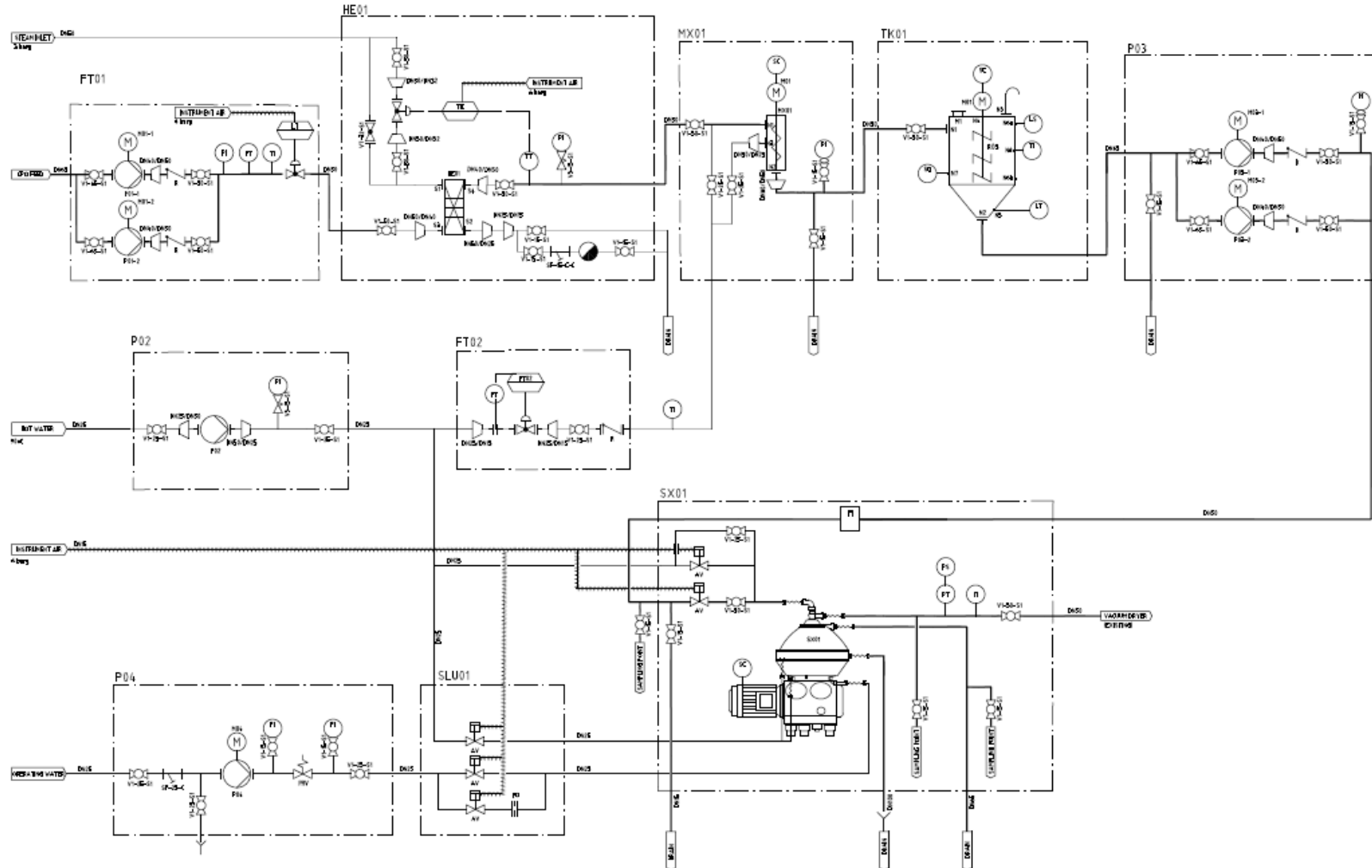
Source: MPOB, Malaysia Palm Oil Board

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Alfa Laval CPO washing process



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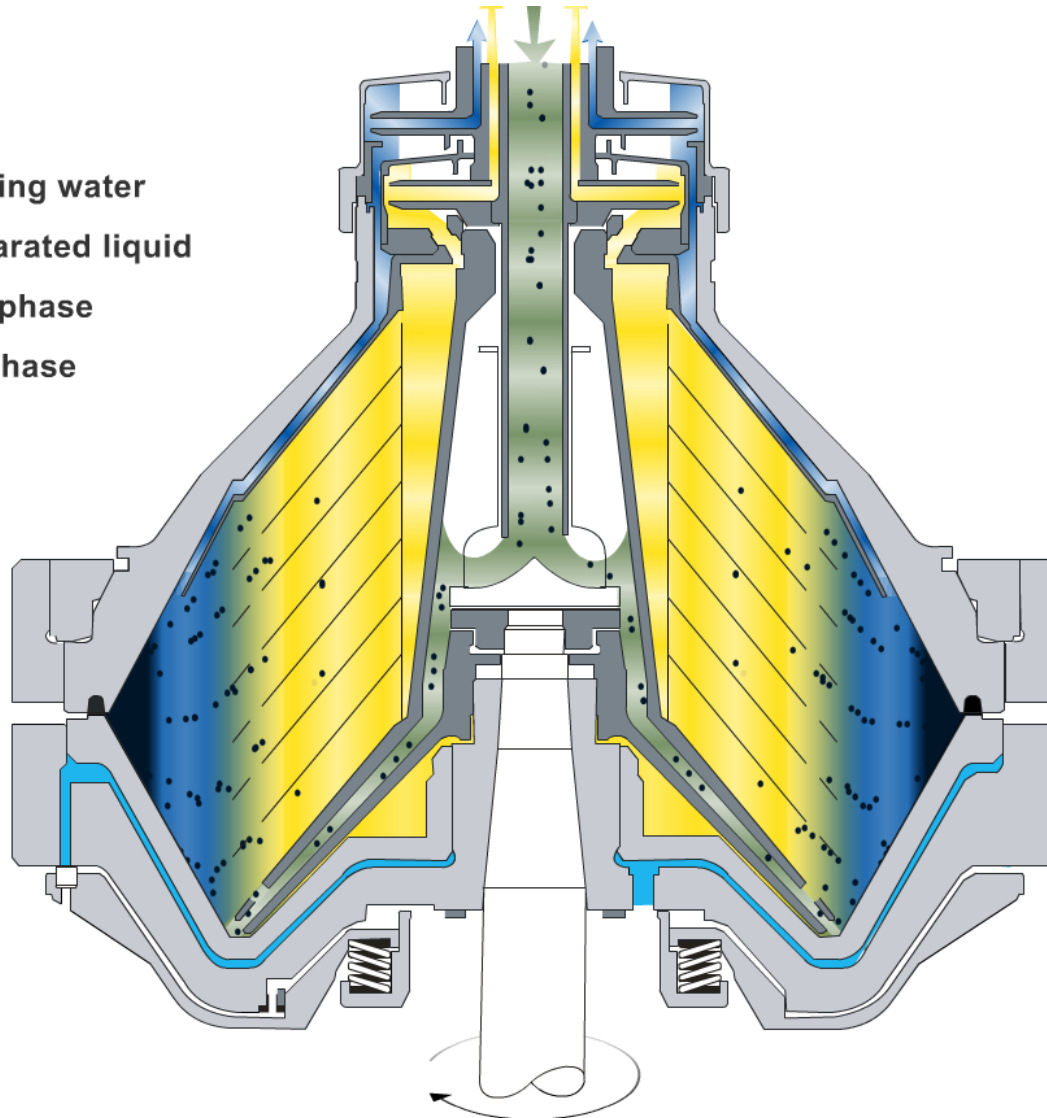


CPO Washing to remove chlorine, a precursor to 3-MCPD



CPO Washing to remove chlorine, a precursor to 3-MCPD

- Operating water
- Unseparated liquid
- Heavy phase
- Light phase
- Sludge



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FEED

WASHED OIL

**WASHED
WATER**

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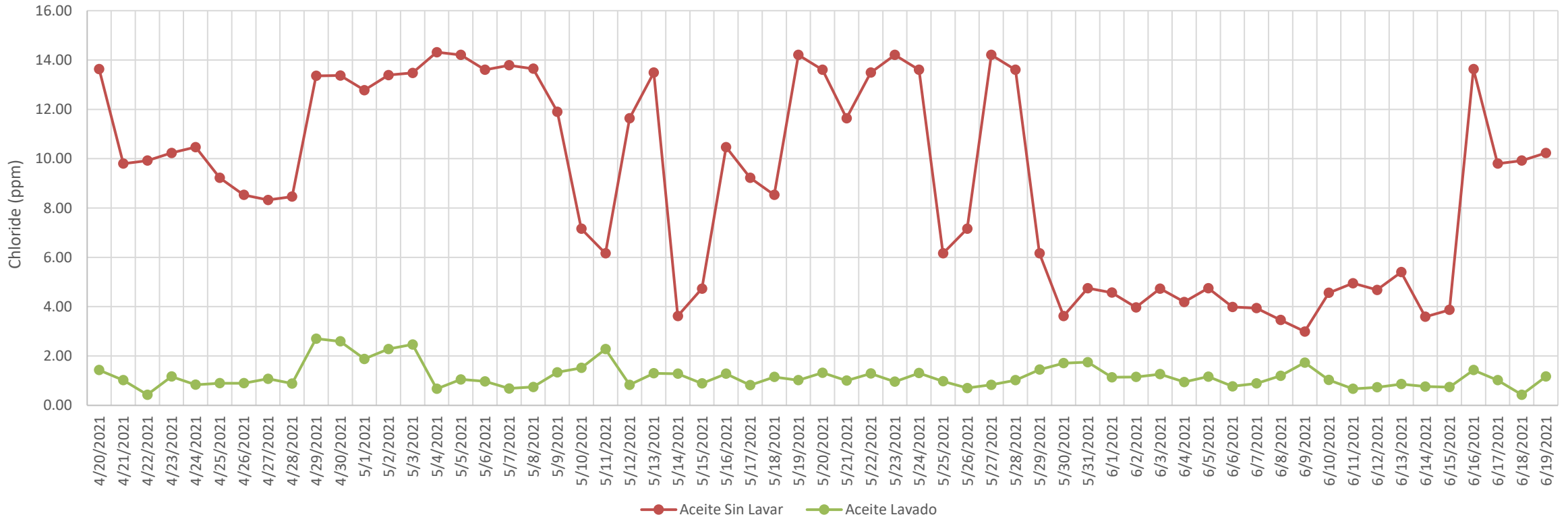
Results from SEA reference

Date	Capacity	Washing Water (%)	Feed to Washing plant		VO 30 Oil Phase		After Vacuum Dryer		Washed Water		
			Moisture	Chloride	Moisture	Chloride	Moisture	Chloride	Oil	NOS	Moisture
			%	ppm	%	ppm	%	ppm	%	%	%
27-Aug-18	10 mt/hr	8%	0.64%		0.34%		0.19%		0.77%	1.65%	97.58%
30-Aug-18	12.5 mt/hr	8%	0.49%	6.009	0.39%	0.501	0.17%	0.361			
13-Sep-18	12.5 mt/hr	8%	0.43%		0.52%		0.17%				
20-Sep-18	12.5 mt/hr	8%	0.38%	4.131	0.52%	0.739	0.19%	0.666	0.15%	2.02%	97.83%
22-Sep-18	12.5 mt/hr	8%	0.36%		0.56%		0.20%		0.68%	1.90%	97.42%
24-Sep-18	12.5 mt/hr	8%	0.52%		0.44%		0.17%		1.22%	1.71%	97.07%
26-Sep-18	12.5 mt/hr	8%	0.43%		0.37%		0.20%				
04-Oct-18	12.5 mt/hr	8%			0.51%				0.27%	0.38%	99.35%
	14.0 mt/hr	8%			0.58%				1.37%	0.21%	98.42%
06-Oct-18	12.5 mt/hr	8%	0.33%		0.57%		0.16%		0.59%	0.10%	99.31%
09-Oct-18	12.5 mt/hr	8%			0.49%				0.17%	0.33%	99.50%
	14.0 mt/hr	8%			0.74%				1.21%	0.29%	98.50%
27-Dec-18			0.55%	4.295	0.48%	0.43	0.136	0.272	1.13%	0.21%	98.66%
					0.50%				0.76%		

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Results from LATAM reference

Average unwashed CPO 9.10 ppm
Average washed CPO 1.18 ppm



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Side benefits of other contaminants removal

Parameter		Unwashed CPO	Washed CPO, 5% water
FFA	%	4.9	4.8
Moisture	%	0.11	0.1
P	ppm	30.1	14.6
Na	ppm	4.5	<2,0
Mg	ppm	8.6	1.2
Ca	ppm	42.7	6.5
Fe	ppm	9.01	1.9

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Oil Losses calculation

For Palm Oil Mill	Per Day
FFB processed, tons	1200.00
Mill operating hours per day	20
Oil Extraction Rate (OER), %	20.00
CPO Produced, tons	240.00
Washing water, %	5.00
Washing water added, m3	12.00
Oil loss in purifier effluent, (%OWB)	1.00
Total Oil loss, tons	0.12
Oil losses to FFB, %oil / tFFB	0.010%



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How do we analyse Chloride content in Crude Palm Oil?

What method do we use?



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Total chlorides content in oil

Malaysian Palm Oil Board (MPOB) recommend an analytical procedure published on 9th March 2022 for total chlorides measurement using modified ASTM D4929-16 analytical procedure using a Total Chloride Analyser (TCA) on the basis of Mitsubishi NSX-2100H analyser.

METHOD FOR THE DETERMINATION OF TOTAL CHLORIDE CONTENT IN EDIBLE OILS

ABDUL NIEFAIZAL ABDUL HAMMID¹; AZMIL HAIZAM AHMAD TARMIZI¹; MUHAMAD RODDY RAMLI^{1*};
AINIE KUNTOM¹ and LEE HOCK CHIN²

ABSTRACT

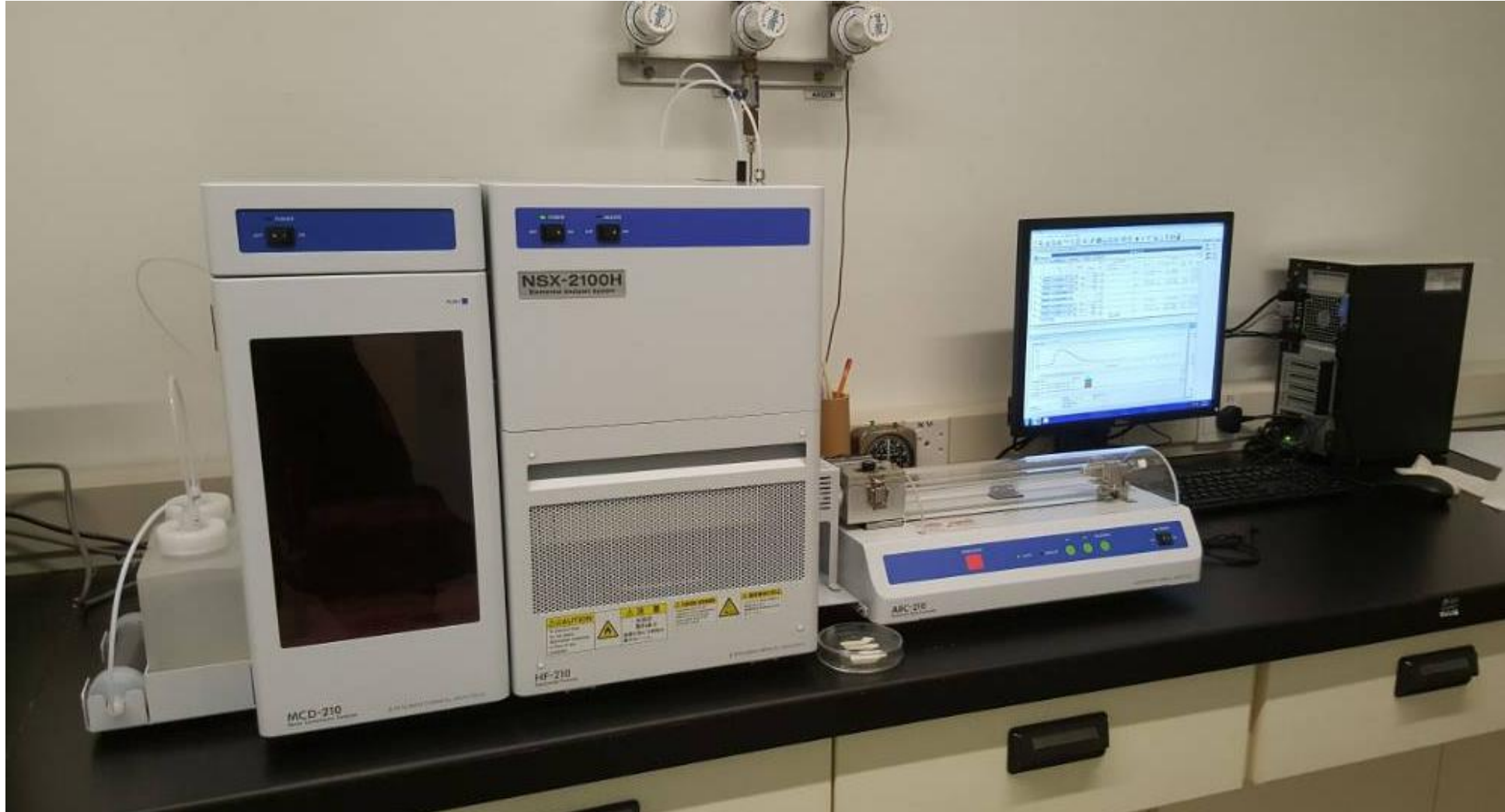
Edible oils are important component of food products and have to meet with food safety requirements. However, a group of compounds called chloropropanols has been detected in edible oils which have compromised its safety. The precursor for these compounds is chloride. The chlorinated compounds can be 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 $\mu\text{g mL}^{-1}$, 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 $\mu\text{g mL}^{-1}$, respectively. The results indicated that this method could be used for routine analysis of TC in edible oils.

Source: Journal of Oil Palm Research DOI: <https://doi.org/10.21894/jopr.2022.0016>

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

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STANDARD SPECIFICATION

Model NSX-2100H

Trace Nitrogen, Sulfur and Halogen Analyzer system utilizing oxidative sample combustion.

Trace Elemental Analyzer NSX-2100H	
Samples	Solid, Non-aqueous liquid, Gaseous, LPG
Analytical method	Oxidative Pyrolysis and detection
Furnace	Max. 1,100°C, two part independent controlled. Horizontal electric furnace HF-210. Open/Close type.
Detector	Ultraviolet Fluorescence (UVFL) for Sulfur - Model SD-210, temperature controlled cell Chemiluminescence (CLD) for Nitrogen - Model ND-210, temperature controlled cell Microcoulometry for Chlorine and Sulfur - Model MCD-210.
Measuring range	UVFL-Sulfur solid: 0.05-10,000µg/g, liquid: 0.05 - 5,000µg/ml CLD-Nitrogen solid: 0.5-5,000µg/g, liquid: 0.2 - 5,000µg/ml Coulometry Chlorine 0.01 - 500µg (0.1 - 5,000µg/ml) Coulometry Sulfur 0.05 - 50µg (0.5 - 500µg/ml)
Typical sample size	Solid 30mg (up to 150mg) Non-aqueous liquid 50µl (up to 100µl)
Measuring time	UVFL/CLD 3-10min. (simultaneous Nitrogen/Sulfur available) Coulometry less than 10min
Gas	Ar and O ₂
Others	Vacuum pump for ND-210
Electric	100-240VAC 50/60Hz

Module specification	Power consumption	Dimension WDH mm	Mass
Furnace HF-210	1000 VA	320 x 430 x 500	25Kg
Detector SD-210	150 VA	220 x 375 x 500	21Kg
Detector ND-210	300 VA	220 x 375 x 500	22Kg
Detector MCD-210	150 VA	220 x 375 x 500	14Kg

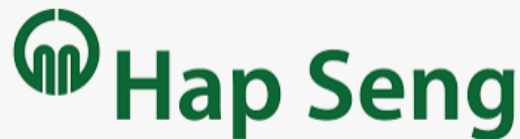
PC	
OS	Microsoft Windows® 7 professional 32bit
Processor	2.4 GHz or more
Memory	2 GB or more
HD	160 GB or more
Drive	one CD-ROM or DVD disk drive
Display	15 inches display or more
Printer	compatible to OS
Port	1 serial port (RS-232C, D-sub9)



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IOI GROUP



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CALIFICA A NUESTRO CONFERENCISTA



PhD. Boon Kheng Hong