CPO Washing for mitigation of 3-MCPDE

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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.

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-MCPDE is, and how to reduce its formation in edible oil refining.

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 (1)	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.	— (*****)

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.

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.

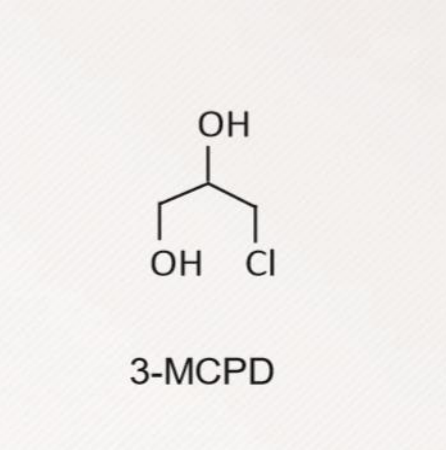
To mitigate the formation of 3-MCPDE, this contaminant must be reduced or removed from the Crude Palm Oil before refining.

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



3-Monochloropropane-1,2-diol

: Formula = $HOCH_2CH(OH)CH_2Cl$

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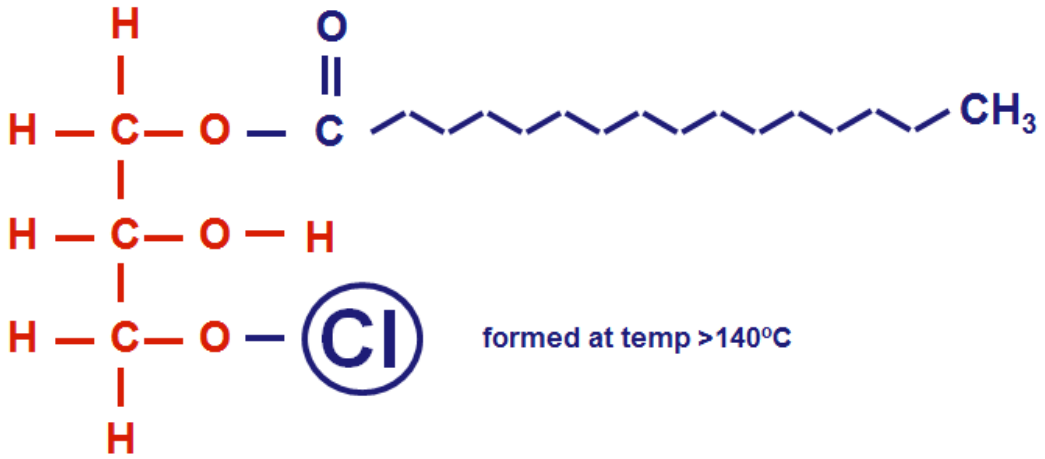
$$TAG/DAG/MAG + Cl^- + H^+ \xrightarrow[>140°C]{} 3\text{-}MCPDE$$



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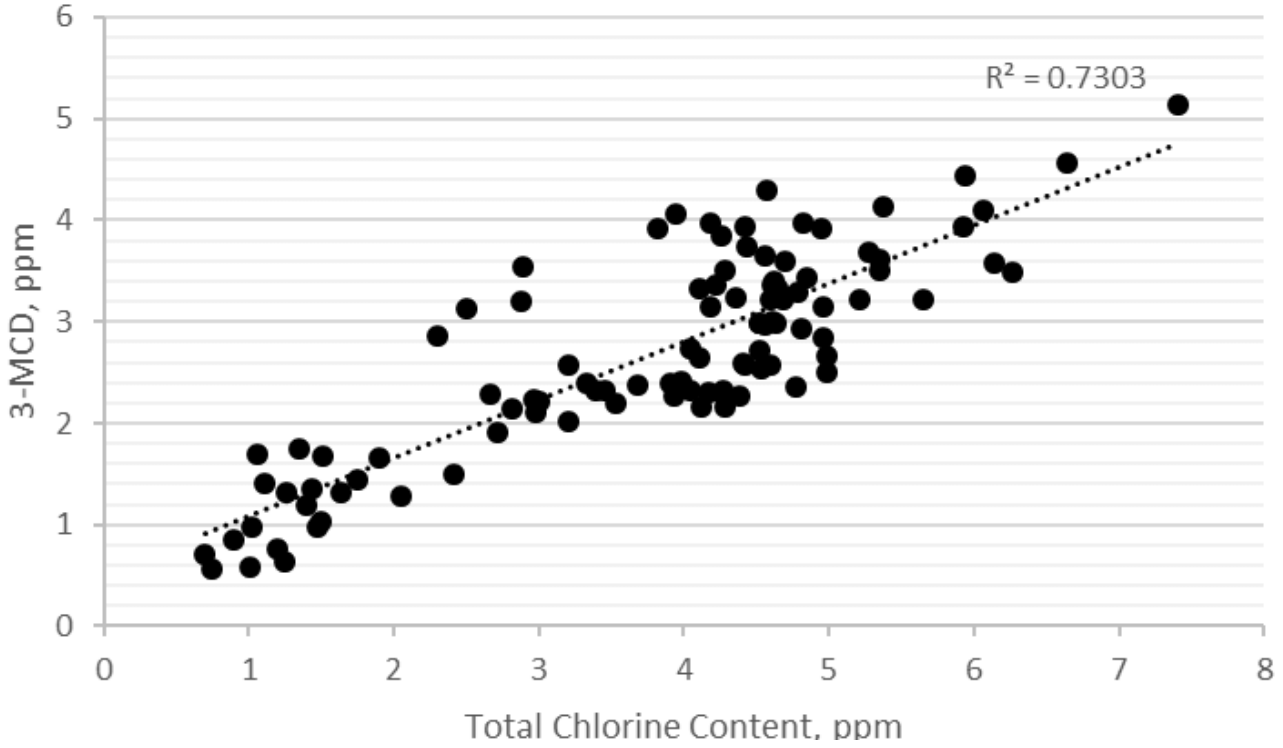
3MCPDE is formed in heat-processed fatty foods from glycerol or acyl glycerides in the presence of chloride ions. The formation of 3MCPDE is an irreversible process. Once formed, there is no known method by which it can be removed.

$$\text{TAG/DAG/MAG} + Cl^- + H^+ \xrightarrow[>140°C]{} \text{3-MCPDE}$$

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



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

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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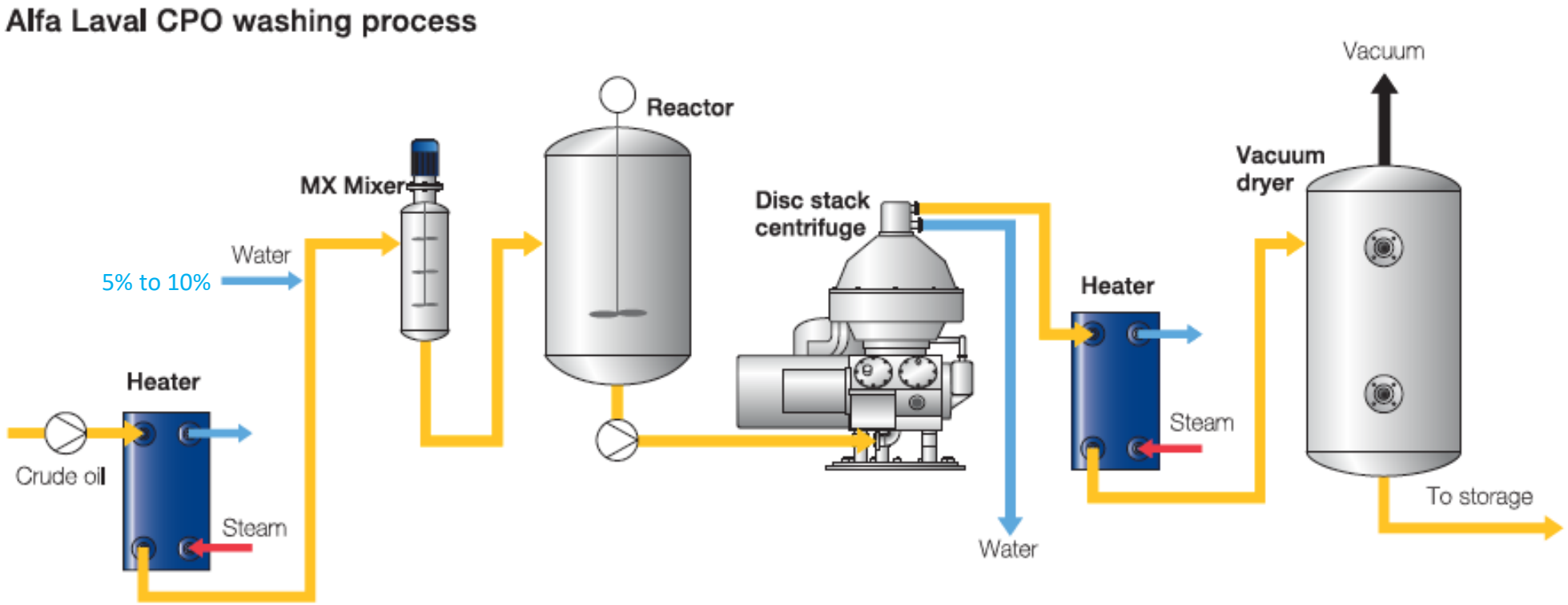

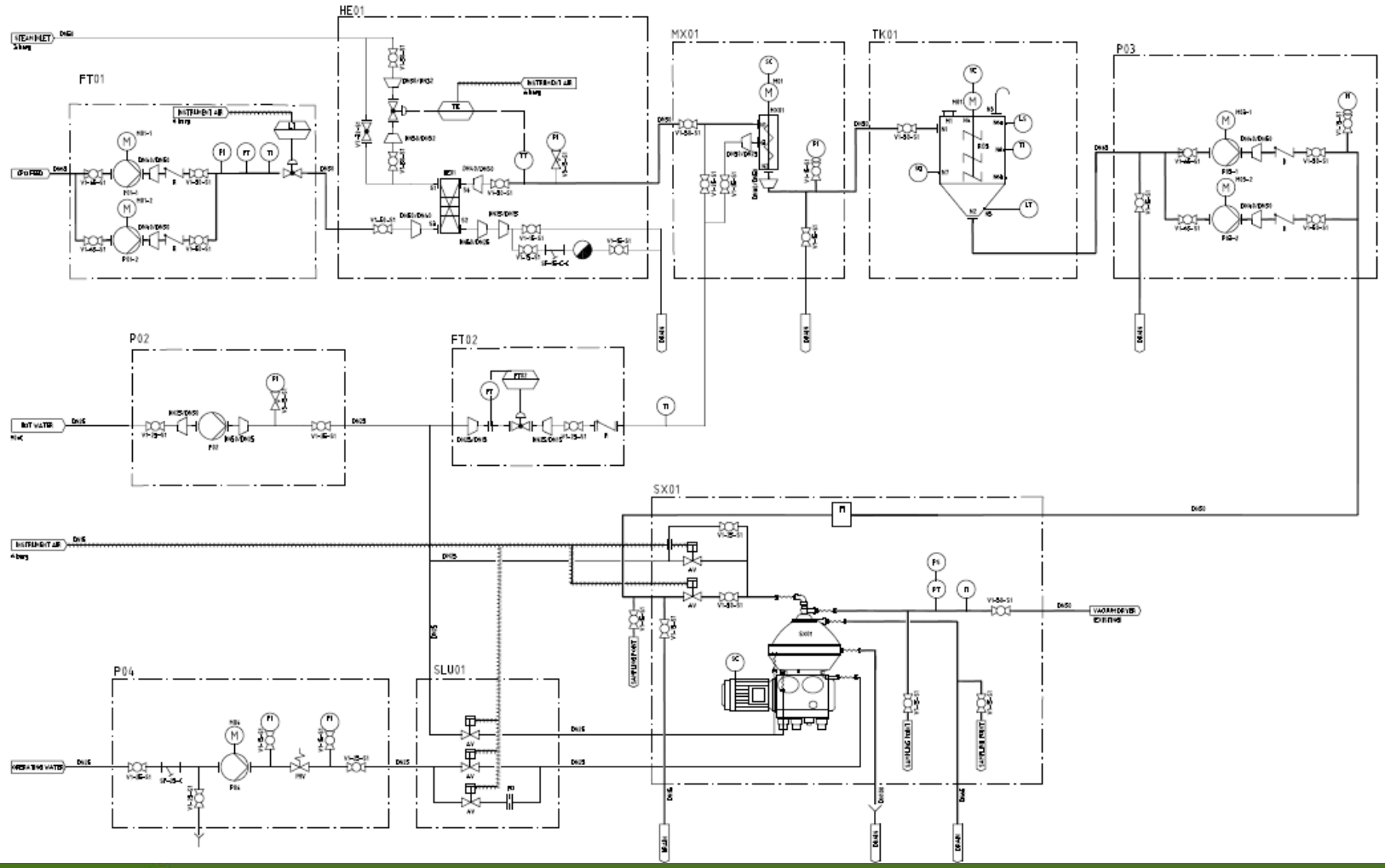
HE01
MX01
TK01
P03
FT01
P02
FT02
SX01
P04
SLU01

CPO Washing for mitigation of 3-MCPDE

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FEED

WASHED OIL

WASHED WATER

Results from SEA reference

DATE	09/06/2017		09/06/2017		10/06/2017		10/06/2017	
CPO + Condensate Temp. °C	90		70		70		80	
CPO Flowrate, Mt/Hr	5.5		4		4		6	
Condensate Flowrate, L/Hr	300		300		300		300	
Sampling Point	CPO Header	After centrifuge	CPO Header	After centrifuge	CPO Header	After Centrifuge	CPO Header	After centrifuge
Total chloride	13.63	1.43	9.8	1.02	9.92	0.43	10.23	1.17

	Control						Washed					
	FFA, %	Color	DOBI	TC, ppm	3-MCPD,ppm	GE, ppm	FFA, %	Color	DOBI	TC, ppm	3-MCPD,ppm	GE, ppm
CPO	4.712		2.634	5.741			4.612		2.669	0.982		
BPO				3.356						0.785		
RBDPO	0.011	3.0R 30Y		2.864	3.48	1.06	0.011	2.8R 30Y		0.567	0.58	0.87

Results from SEA reference

Date	Capacity	Washing Water (%)	Feed to Washing plant		VO 30 Oil Phase		After Vacuum Dryer		Washed Water		
			Moisture %	Chloride ppm	Moisture %	Chloride ppm	Moisture %	Chloride ppm	Oil %	NOS %	Moisture %
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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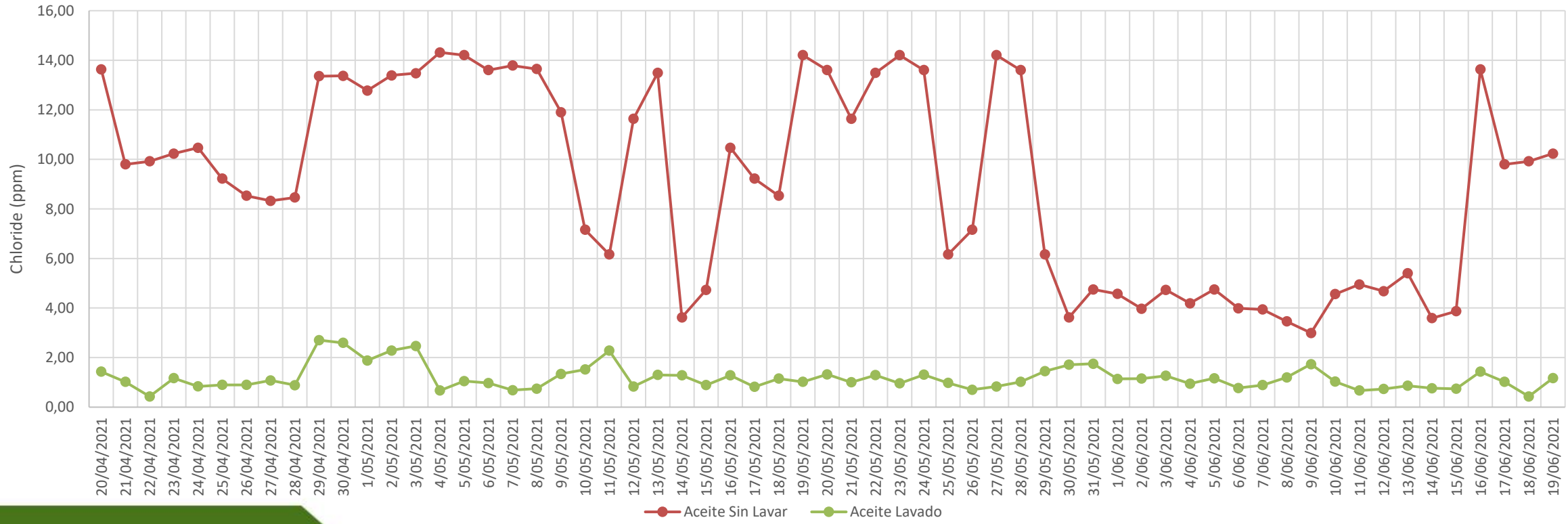
Results from LATAM reference

Average unwashed CPO **9.10 ppm**
Average washed CPO **1.18 ppm**



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

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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GRUPO HAME

Sime Darby Plantation

IOI GROUP

Kulim (Malaysia) Berhad

smart agribusiness and food

PROLADE sustainable palm oil

wilmar

United Malacca Berhad

SAWIT KINABALU

TH GROUP

Hap Seng

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Thanks