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3-MCPD ester and glycidyl ester – Mitigation strategies during the production of vegetable oils and fats

**Nathalie LECOCQ
Director General**



Presentation Outline

1. About FEDIOL
2. FEDIOL work and current context
3. FEDIOL approach for mitigation
4. FEDIOL mitigation toolbox 3MCPDE
5. FEDIOL mitigation toolbox GE
6. Conclusion



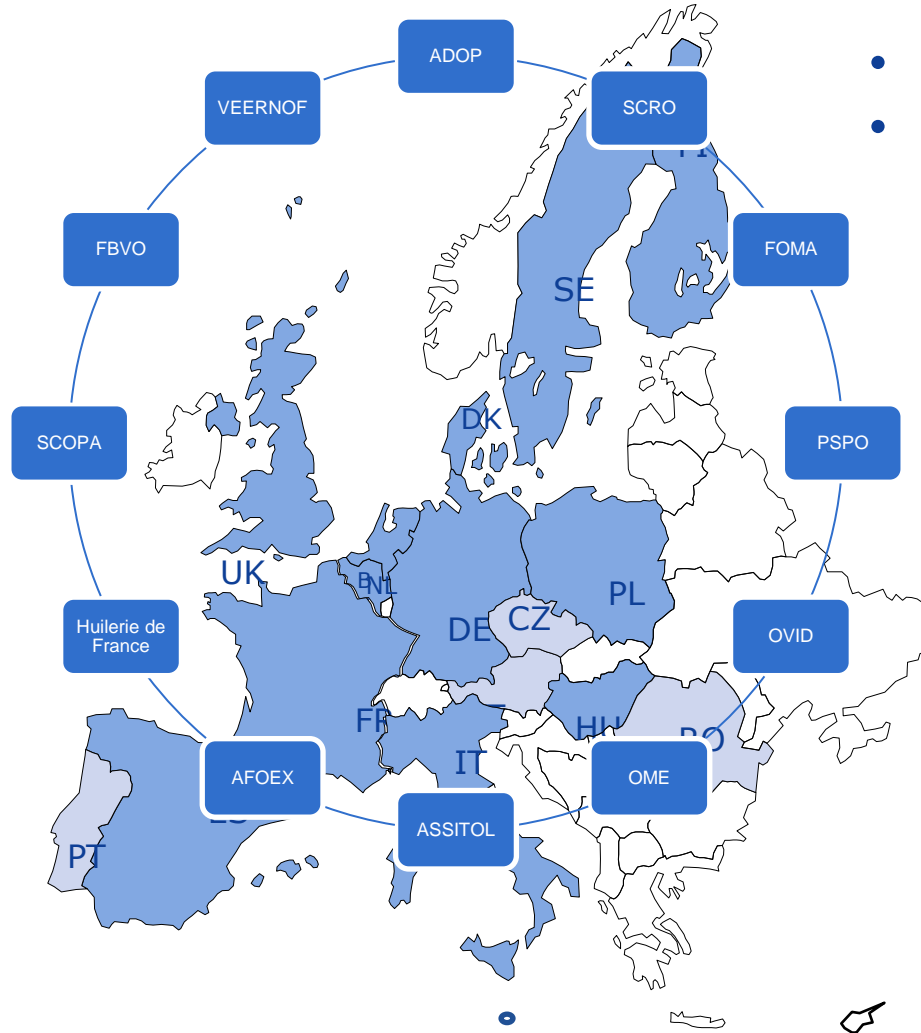
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FEDIOL member associations

- 12 Associations
- Companies in 5 other member states



FEDIOL in a few facts

- 36 million tonnes oilseeds crushed
- 26 million tonnes meals produced
- 13 million tonnes of oils refined for use in food (sunflower, rapeseed, palm and soy...)
- 85% of the market covered
- 150 plants from ± 35 companies
- 20.000 direct jobs



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Why is FEDIOL working on MCPDE and GE?

- **Concerns raised** on 2- and 3-MCPDE and GE occurrence
- FEDIOL **overall commitment** to ensuring food safety
- FEDIOL need to **better comprehend** the issue in order to identify priorities and measures to implement



FEDIOL overall goals on MCPDE and GE

- Develop a **good understanding** of the contribution of vegetable oils and fats to MCPDE and GE occurrence by collecting data, developing an exposure assessment of the contribution of vegetable oils and fats and identifying actions to undertake
- Develop proactively and implement **viable mitigation technologies** to reduce MCPDE and GE levels in vegetable oils and fats as far as reasonably achievable
- **Follow-up and continue engaging actively** in scientific and regulatory developments
- **Continue developing synergies** with food industry stakeholders to address the issue



Background: Analytical Methods

For vegetable oils and fats

- 3 AOCS indirect validated methods i.e. Unilever, SGS and DGF methods Cd 29a-13, Cd 29b-13 and Cd 29c-13

	Unilever ¹ (AOCS Official Method Cd 29a-13)	SGS ² (AOCS Official Method Cd 29b-13)	DGF ³ (AOCS Official Method Cd 29c-13)
3-MCPD esters	✓	✓	✓
2-MCPD esters	✓	✓	✗
Glycidyl esters	✓	✓	✓*

1. Ermacora & Hrncirik, *J. Am. Oil. Chem. Soc.*, 90, 1-8 (2013)
2. Kuhlmann, *Eur. J. Lipid Sci. Technol.* 113, 335-344 (2011)
3. DGF Standard Methods. C-VI 18 (10).

For more complex food matrixes

- Validated methods still pending



FEDIOL data collection:

- 2014 data collection finalised in May and submitted to EFSA
- Renewed FEDIOL call to members on 2- and 3-MCPDE and GE until March 2015

FEDIOL model:

- FEDIOL complex model to estimate exposure to oils and fats in Europe shared with EU authorities at the end of 2013 (valid for contaminants in general)
- Validation process ongoing - current assessment of model by external expert with scientific paper to be subsequently published – expected by end 2014.



FEDIOL work - overview

FEDIOL mitigation work:

- 2013 **Review of available literature** on mitigation techniques
- 2014 **Mitigation Toolbox** aimed at providing guidance and direction to operators and members
 - Gives a “snapshot” at a point in time of available published science to prevent & mitigate 3-MCPDE and GE
 - Shared with EU and national authorities
 - To be regularly updated in view of new scientific developments



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Approach to mitigation toolbox

- Look at the different steps and functions of the refining process
 - Chemical refining
 - Physical refining
- Indicate for each step in the process the mitigation possibilities/techniques
- Indicate if there are limitations or downsides to these techniques



Physical refining of oils



Crude Oil

Degumming

Bleaching

Deodorizing

Refined Oil



Chemical refining of oils



Crude oil

Degumming

Neutralizing

Bleaching

Deodorizing

Refined Oil



Comments on the toolbox use



- **No single "right" approach** to mitigation
- Each operator to develop its **own mitigation approach** according to its processes and its raw materials
- Different mitigation measures can reduce GE whilst increasing 3-MCPDE and *vice versa*.
- Mitigation is a **full supply chain issue**: whilst mitigation can be applied in *refineries*, much can also be achieved at the *harvesting* and *crushing* sources.

Comments on the toolbox use

- **Limitations** to mitigation include higher capital cost, increased processing costs, production losses, effects on functionality/organoleptic properties and environmental implications (additional waste generation...), or more likely a combination of these factors.
- **Consideration** must be given **to the effects** of any mitigation in respect of Good Manufacturing Practices that are in place to ensure food safety, for example processing temperatures on the quality specifications of the oil.



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1) Influencing the quality of the crude oil

+ Reducing free fatty acids (FFA)	+ Reducing chlorinated precursors
<ul style="list-style-type: none"> - Difficult to source - Can increase again during transport 	<ul style="list-style-type: none"> - Difficult to identify in crude oil and cannot be monitored to date

2) During degumming



+ Water washing of crude oils prior to refining
<ul style="list-style-type: none"> - Requiring specific equipment - High level of water needed – environmental impact - Oil yield reduced





3) During neutralization

+ Chemical refining (action on chlorinated precursors, hence 3MCPD esters)

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- Only applicable in case of chemical refining
 - Requiring specific equipment in case physical refining
 - Oil yield reduced; high levels of soap stocks
 - Implementation not economically viable to date on a large scale for tropical oils



4) During bleaching

+ Applying neutral bleaching earths

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- Impacts on product quality i.e. colour, flavour and stability (shelf-life) possible



5) During deodorisation (chemical or physical refining)

+ Optimised deodorisation process for deacidification (physical refining) and reduced temperatures (chemical refining)

- Last stage of physical refining uses generally higher temperature than chemical refining and can increase 3-MCPDE levels
- Minimum temperatures needed to ensure quality requirements and organoleptic properties are met
- Requiring specific equipment



6) Fractionation



+ Reducing 3-MCPDE levels for harder fractions

- Higher levels in softer/liquid fractions

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1) At crude oil level

+ Reducing free fatty acids (FFA) & diacylglycerol (DAG)

- Can increase again during transport
- Difficult to source low FFA materials



2) During neutralization (chemical refining)

+ Removing Free Fatty Acids (FFA)

- Only applicable in case of chemical refining
- Requiring specific equipment for physical refining
- Implementation not viable to date for tropical oils
- Oil yield reduced & triggers high levels of soap stocks – environmental impacts






3) During deodorisation



+ Optimised deodorisation process (physical refining) and lower deodorisation temperatures (chemical refining)

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- Last stage of deodorisations in physical refining uses higher temperatures, which can result in significant higher GE
 - Need to ensure quality and organoleptic requirements are met



4) Fractionation



+ Reducing GE levels for harder fractions

- Higher levels in softer/liquid fractions

5) During post-refining

+ Re-bleaching	+Re-deodorisation
<p>- Significant plant capacity loss (or reduced oil yield) as re-bleached oils/fats need to re-deodorise</p>	<p>- Re-deodorisation can increase GE levels if not done at temperatures below 230°</p>



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Conclusion on FEDIOL mitigation

- Available measures to mitigate 3-MCPDE and GE in published science
- Some of these may be subject to patent applications;
- Apply tailor-made solutions and not a one-fits all approach
- Challenges in terms of efficiency, environment, investments needed to maintain capacities or adjust certain processes etc.
- Industry working on continuous development





Thank You !

For more information, please visit the FEDIOL
website www.fediol.eu