Mitigation strategies for 3-MCPD- and Glycidylesters in food applications

Dr. Nils Hinrichsen, ADM Research, Hamburg
Agenda

• Introduction
  • ADM

• 3-MCPD- and Glycidolester reduced products
  • Products based on 100% palm
  • Products based on blends of palm and other oils

• Lab/Pilot scale vs. Production conditions
The Needs of our World are Growing

Population Growth: More Food

Need for Energy Security and Diversity

Growing Interest in Environmental Improvement
We Source and Transport Crops
ADM Processing per Day

- 108,000 t
- 66,400 t
- 27,000 t
- 1,800 t

265 processing plants
We Transform Crops into Products that Serve Vital Needs
Our Assets Span the Globe

- Sourcing facilities
- Oilseed processing
- Corn processing
- Cocoa & wheat processing
- Wilmar

- Sourcing distribution
- Processing distribution
Our Performance Has Been Strong

Net Earnings in $ Billions

<table>
<thead>
<tr>
<th>Year</th>
<th>Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>$2.1</td>
</tr>
<tr>
<td>2008</td>
<td>$1.8</td>
</tr>
<tr>
<td>2009</td>
<td>$1.7</td>
</tr>
<tr>
<td>2010</td>
<td>$1.9</td>
</tr>
<tr>
<td>2011</td>
<td>$2.0</td>
</tr>
</tbody>
</table>
ADM’s Mitigation Strategies

• Whilst it is well known that reduced temperature can help mitigate Glycidyl Esters and to an extent 3-MCPD esters

• ADM’s mitigation strategies have maintained existing temperature profiling to ensure overall integrity and quality of processed oils

• ADM has developed several processes for the reduction of both 3-MCPD and Glycidyl Esters

• These processes have been upscaled from pilot to production conditions

• ADM does presently offer low 3-MCPD/Glycidyl Ester products based on palm and on palm reduced formulations.
3-MCPD- and Glycidolester reduced products
100% Palm based products

<table>
<thead>
<tr>
<th>Average mg/kg free 3-MCPD</th>
<th>Reduction GE + 3-MCPD</th>
<th>Reduction GE</th>
<th>Reduction 3-MCPD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>~ 72 %</td>
<td>~ 94 %</td>
<td>~ 33 %</td>
</tr>
<tr>
<td></td>
<td>~ 82 %</td>
<td>~ 92 %</td>
<td>~ 65 %</td>
</tr>
</tbody>
</table>

- **Glycidol**
- **3-MCPD**
Solid Fat Profile of Palm Oil

SFC [%]

Palm Oil
Palm Oil process 2

Temperature [°C]

N10  N20  N30  N35  N40
Example: Palmoil

Palm, no treatment
Palm, process 2
100% Palm based products

**Reduction GE + 3-MCPD** ~ 66%

**Reduction GE** ~ 96%

**Reduction 3-MCPD** ~ 19%

- **PMF 45**
- **PMF 45 process 3**
Solid Fat Profile of Palm Oil Fractions

![Graph showing the solid fat content (SFC) percentage for different palm oil fractions (N10, N20, N30, N35, N40) at various temperatures (°C). Two curves are shown: PMF 45 and PMF 45 process 3. The graph illustrates the decrease in SFC percentage as the temperature increases.](image-url)
Palm Oil reduced products

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Reduction GE</th>
<th>Reduction 3-MCPD</th>
<th>GE + 3-MCPD Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original Blend</td>
<td>~ 93 %</td>
<td>~ 62 %</td>
<td>~ 84 %</td>
</tr>
<tr>
<td>Version 1</td>
<td>~ 93 %</td>
<td>~ 70 %</td>
<td>~ 86 %</td>
</tr>
<tr>
<td>Version 2</td>
<td>~ 93 %</td>
<td>~ 70 %</td>
<td>~ 86 %</td>
</tr>
</tbody>
</table>

Average mg/kg free 3-MCPD

- Glycidol
- 3-MCPD
Additional health benefit

- Reduction of saturated fatty acids

- Comparison between original blend, version 1, and version 2.
Lab/Pilot scale vs. Production conditions
Lab vs. Plant refining

Example: Refining of Palm fraction:

Same refining parameters have been applied for both trials.
Comparison of different production lines

Example: Refining of Filling Fat:

Same refining parameters have been applied for both trials.
Comparison of different production lines

Example: Refining of Filling Fat:

Modified refining parameters have been applied production line 1.
Conclusions

• ADM has and continues to invest in identifying and developing 3-MCPD- and Glycidolester reduction

• ADM has developed various strategies for the reduction of 3-MCPD and Glycidyl Esters whilst maintaining product integrity. These processes are commercially available.

• ADM does presently have available functional products, that also offer reduced 3-MCPD/Glycidyl Ester solutions

• Upscaling to plant conditions of promising lab results has been done successfully

• Process has to be fitted to production line and application of the product
Questions ?