Optimising the Baking and Frying Process Using Oil Improving Agents

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Within food companies, trans reduction is always a top-three priority item.

Dr. Willie Loh, National Sales Manager, Cargill Speciality Canola Oils

- Reduction of trans fatty acids
- Reduction of acrylamide level
- Reduction of total fat content

Use of additives may be a possibility to solve some of these problems
Legal Definition of Additives or Agents

- An ingredient of a food not normally of itself consumed as a food
- and
- having a function useful in the food
Additives in Deep Frying Fats

- Organic Acids (Citric acid and salts)
- Antioxidants (BHT, BHA, Gallates, TOC)
- Antifoam (DMPS)
- Anti-spattering agent (Lecithin)
- Emulsifiers (Fatty acid esters or citric esters of mono-und diglycerides)
Purpose of Additives

- To delay the chemical degradation of the fat (FFA, Colour, Polar Materials)
  - Antioxidants, Citric acid, Adsorbens

- To change the physical properties of fat (viscosity, heat transfer, interfacial tension)
  - Antifoams, Emulsifiers, Filter Aids, Absorbens
Aim of the Use of Additives

Oil: Better heat and oxidative stability
Constant oil quality
Shorter heating time and lower temperature
Replacement of unhealthy hardened fats with trans free oils

Product: Better taste and texture
Less oil uptake by the foods
Lower level of toxic substances
Reducing Oil-Uptake

- Frying temperature and duration
- Prefrying treatments (blanching et drying)
- Coating
Changing of PV, AV and PTG during heating of Sunflower Oil at 105°C and 135°C.
Stabilizing Agents for Deep Frying Fats and Oils

- **< 130 °C**
  - Antioxidants as radical scavengers
  - Phenolic compounds forming quinones
    (BHT, BHA, TBHQ, gamma- and delta tocopherols)

- **> 130 °C**
  - Antipolymerising agents:
  - Compounds, forming dimeric products by proton catalysed reactions (dehydratisation)
## Antipolymerising agents

<table>
<thead>
<tr>
<th>Substance</th>
<th>Reaction product</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sesamolin</td>
<td>Sesamol, Sesamin, Sesaminol</td>
<td>130 °C</td>
</tr>
<tr>
<td>Phytosterols</td>
<td>Steradienes</td>
<td>150 °C</td>
</tr>
<tr>
<td>Ascorbic palmitate</td>
<td>Dehydro-Ascorbic Palmitate</td>
<td>150 °C</td>
</tr>
<tr>
<td>Alpha Tocopherol</td>
<td>Tocopherol-Trimer</td>
<td>160 °C</td>
</tr>
<tr>
<td>Squalene</td>
<td>Tetracyclosqualene</td>
<td>170 °C</td>
</tr>
</tbody>
</table>
Natural Antioxidants/Angents

- Unsaponifiables isolated from:
  - olive
  - corn
  - wheat germ

- Extract (ethanolic, petrolether) from:
  - rosemary
  - oregano
  - sage
  - savory
  - oat
## Water Containing Agents

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>Water content</th>
<th>Antioxidants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oilmaster</td>
<td>Emulsion (W/O)</td>
<td>Ca. 20 %</td>
<td>ACP, TOC, Citric Acid</td>
</tr>
<tr>
<td>Miroil Powder</td>
<td>Powder (Perlite)</td>
<td>Ca. 50 %</td>
<td>Citric acid</td>
</tr>
<tr>
<td>Miroil Fryliquid</td>
<td>Emulsion (O/W)</td>
<td>Ca. 50 %</td>
<td>Rosemary extract, Citric acid</td>
</tr>
</tbody>
</table>
Improvement of the Heat Transfer with Oilmaster

Test: crude potatoes, 15*15*600 mm; Frying oil: Sunflower

- 170 °C without OM
- 170 °C with OM
- 152 °C without OM
- 152 °C with OM

Graph showing the temperature (Food Center) °C over Heating time [sec].
Accelerated formation of acrylamide in French Fries with increasing usage of the frying oil

168 °C, 3 min, 680 g French Fries, partially hydrogenated rapeseed oil with E900.

Accelerated formation of acrylamide with increasing number of batches in DMPS containing frying oils.

Graph showing the relationship between fryer heating time (min) and acrylamide concentration [µg/kg French fries].
Formation of acrylamide with increasing weight of fried French fries and heating time of the deep-frying oil.

- 168 °C, 3 min, partially hydrogenated rapeseed oil containing E 900.
Emulsifiers

- Fatty acid ester of mono-, and diglycerides
- Citric ester, Lactic ester, Tartaric ester of mono- and diglycerides
- Polyoxi ethylene sorbitan monoleate
- Polyglycerolester
- Lecithine
Role of Emulsifiers

- Improving interaction food-fat
- Improving texture of the fried food
- Reducing spattering tendance
- Reducing foaming

Disadvantage often:
Increasing oil uptake of the food
Quality Improvement by Treatment with Sprayable Oils Containing Emulsifiers

No treatment  With MF Spray
### Commercially Available Frying Oil Stabilising Formulations

<table>
<thead>
<tr>
<th>Name</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guardian RE 08</td>
<td>Rosemary extract, E472c, E471</td>
</tr>
<tr>
<td>Guardian RE 09</td>
<td>Rosemary extract, Polyoxy-ethylene sorbitan monooleate, E472c, E471</td>
</tr>
<tr>
<td>Grindox 1021</td>
<td>ACP, Tocopherol extract, E472c, E471</td>
</tr>
<tr>
<td>Grindox 1029</td>
<td>ACP, E472e, E471</td>
</tr>
<tr>
<td>Good Fry Constituents</td>
<td>Rice bran, Sesame oil</td>
</tr>
<tr>
<td>Oilmaster</td>
<td>ACP, TOC, E471, E472c, Citric acid, Water</td>
</tr>
<tr>
<td>Miroil Fryliquid</td>
<td>Citric Acid, Water, Rosemary extract</td>
</tr>
<tr>
<td>Maxfry Classic nat</td>
<td>Tocopherol extract, Rice bran, Sesame oil, E471, E472b, E472c, Citric Acid</td>
</tr>
<tr>
<td>Maxfry Classic</td>
<td>ACP, Tocopherol extract, Rice bran, Sesame oil, E471, E472b, E472c, Citric Acid</td>
</tr>
</tbody>
</table>
Effectiveness of Some Formulations
(OSET-Test, 2h, 170 °C)
Filter Aids and Absorbents

- **Minerals**
  - Calcium silicate: Silarsorb, Hubersorb
  - Calcium carbonate (Pekmez earth)
  - Magnesium silicate: Magnesol
  - Sodium silicate: Britesorb
  - Perlite: Frypowder
  - Silica: Trisyl
  - Bentonite: Tonsil

- **Organic materials**
  - Cellulose: Maxfry Filter Aid
  - Citric acid: Frypowder
Effectiveness of solid additives after addition to used deep-frying oils

1 % resp. 5 % powder added to hot oil (10 % PTG, AV 1,5) at 150 °C, stirred 10 min.
Influence of Some Additives on Oxidative Stability (measured by Rancimat)

*Data Source: B.Matthäus, Bundesanstalt f. Fettforschung 8/2003
Evaluation of Effectiveness of Additives in the Frying Process

- Oil Usage
- Oil Life
- Fryer condition
- Food safety and quality
- Handling
- Costs
- Analytical criteria evaluating oxidation and polymerisation processes (Rancimat, OSET)
Conclusions

- Filter Systems and frying additives have a potential to enhance food quality and extend oil life

But

- It is an error to believe that by filtering, treating or adding of special additives the oil can be used indefinitely.