Dual purpose crop production across a diversity of livestock systems in the EU:

The case of oilseed – production of foods, feeds and fuels.

Patrick Carré

Terres Inovia
About the speaker

**Terres Inovia**: French technical centre for oilseeds and pulses.
- Non-profit organization mainly focused on agronomy
- Staff: >150 people.

**Patrick Carré**: Process engineer
- 35 years of experience
- R&D on oilseeds processing / pilot-plant / impact of technologies on products quality
Oilseeds: multipurpose crops

Extraction of oils from oilseeds results in 2 co-products:

- Oil
- Meal

Oils, production and biodiesel use (Yearly, average 16-19):

- Rapeseed: 12,000 ktons/year
- Sunflower: 5,000 ktons/year
- Soybean: 3,000 ktons/year

Production: 56% for Rapeseed, 9% for Sunflower, 41% for Soybean
Biodiesel: 59% for Rapeseed, 41% for Soybean

Source: Terres Univia
European countries producing > 1Mt/y of oilseeds (average 2016-2020)

Crops in % of arable land

Source: Eurostat
UE Oilseeds crushing overview

Annual production of oil and meals by species (EU / 2016-19)

- Rapeseed: 43.5% Oil, 55.0% Meal, 79.2% Total
- Sunflower: 44.7% Oil, 53.9% Meal, 72.6% Total
- Soybean: 18.7% Oil, 77.4% Meal, 96.1% Total

Added value (value of oil + meals – value of seeds)

- Rapeseed: $22/€ per tonne
- Sunflower: $72/€ per tonne
- Soybean: $18/€ per tonne

Values of Seeds, oil & meals

- Rapeseed: 22% added value
- Sunflower: 72% added value
- Soybean: 15% added value

Oil value in % of sales

- Rapeseed: 33%
- Sunflower: 47%
- Soybean: 40%
Overview of rapeseed & sunflower processing

Seeds: 1000 kg
- Conditionning
- Flaking
- Flakes
- Cooking
- Water: 29 kg
- Cake: 659 kg
- Expeller
- Oil: 312 kg
- Salt: 3 kg
- Hexane: 600 kg
- Extraction
- Miscella: 494 kg
- Distillation
- Marc: 765 kg
- Desolventizing
- Meal: 549 kg
- Oil: 123 kg
- Hexane: 229 kg
Process main features

• Oil is dominant in profitability of oil-mills
• High oil yield (98%)
• Highly optimized process
• Sizing of processing units for economies of scale
• Oligopolistic market with few multinational operators (ABC)
Determinants of competitiveness

- Safety
- Process cost
  - Meal Quality
  - Process temperature moderation
  - Prevention of enzyme activity
- Oil Yield
  - Seeds oil content
  - Use of solvent
  - Preparation process
- Oil Quality
  - Agronomy
  - Genetic
- Profit
  - Energy consumption
  - Temperature of desolventizing
  - Hulling
  - Maximum solvent recovery

Additional terms:
- Genetic
- Agronomy
- Use of solvent
- Preparation process
- Process temperature moderation
- Prevention of enzyme activity
- Seeds oil content
- Meal Quality
- Process cost
- Oil Yield
- Oil Quality
- Safety
- Energy consumption
- Temperature of desolventizing
- Hulling
- Maximum solvent recovery

Note: The diagram shows relationships and processes related to competitive factors in agricultural oil production.
Quality of Rapeseed meals

<table>
<thead>
<tr>
<th></th>
<th>Regular RSM</th>
<th>Dehulled mild processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins</td>
<td>34</td>
<td>43</td>
</tr>
<tr>
<td>NDF</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>ADF</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>Lignin</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Ashes</td>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

Depositebility (pigs)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>67%</td>
</tr>
<tr>
<td>Proteins</td>
<td>77%</td>
</tr>
<tr>
<td>Lysine</td>
<td>5.3% of AA</td>
</tr>
<tr>
<td>Glucosinolates</td>
<td>&lt;10 µMol</td>
</tr>
<tr>
<td>Other phenolic</td>
<td>Bitterness</td>
</tr>
</tbody>
</table>

Dehulling → oil losses
- Rapeseed hulls contains 8% of oil
- Sorting hulls & kernels is difficult

Poor performances of mechanical extraction
- Lack of fiber → lesser pressure generation
- Press cake with poor extractability by lack of structuration
Quality of Sunflower meals

<table>
<thead>
<tr>
<th></th>
<th>“Lopro” SF meal</th>
<th>Available “Hipro”</th>
<th>Potential “Very-Hipro”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins</td>
<td>28</td>
<td>35</td>
<td>&gt;40</td>
</tr>
<tr>
<td>NDF</td>
<td>41</td>
<td>32</td>
<td>26</td>
</tr>
<tr>
<td>ADF</td>
<td>29</td>
<td>22</td>
<td>17</td>
</tr>
<tr>
<td>Lignin</td>
<td>10</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Ashes</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Digestibility % (pigs)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>52</td>
<td>60</td>
<td>66</td>
</tr>
<tr>
<td>Proteins</td>
<td>73</td>
<td>81</td>
<td>87</td>
</tr>
</tbody>
</table>

Technical hurdles

- Dehulling → oil losses
  - Modern SF hybrids: adhering hulls
  - Removing > 60% of hulls is difficult
- Poor performances of mechanical extraction
  - Lack of fiber → lesser pressure generation
  - Press cake with poor extractability by lack of structuration
Emergence of decentralized oil-mills.

In France ➔ development of small units motivated by the need to produce local meals for the high-end market with:

• Locality
• Traceability
• Non-GMO
• No use of solvents.

➔ Result: mechanical extraction only, higher fats content.

➔ Greater interest for proteins quality
Europe: Oilseed sector ≈10% of arable land
- important for crop rotation.

Processing
- Oil yield prevails on meal quality for the operators of large oil-mills

Meal quality
- Dehulling and milder thermal treatment could significantly improve meals quality

Actual perspectives of progress in meal quality
- Oilseeds breeding → Sunflower: hullability, Rapeseed: protein content
- Interesting, emergence of decentralized oil-mill → greater attention to protein uses

Competition feed vs. food
- Protein by-products from oilseed require heavy processing to become edible / humans
- Transformation by animals: not so poor solution.