Wrapping up the day
- knowledge gaps and research needs

Organic pig production - where are we now and where should we be by 2030?

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Future Challenges: (SUSTAINING A PROFITABLE MARKET)

- Justify a substantial market premium
  - Reliably higher product quality
  - Maintain a strongly differentiated image
    - High animal welfare
    - Low environmental impact

- Reduce cost of production
  - Improve feed efficiency
  - Improve prolificacy
  - Reduce mortality
  - Use labour more efficiently

- A reliable, current EU evidence base!
Higher Product Quality

What is quality?
- Product safety
- Nutritional value
- Organoleptic characteristics
- Perception of production methods
Higher Product Quality

Product Safety

- 7/7 studies indicate a lower prevalence of antibiotic resistant bacteria in organically reared pigs
- Salmonella prevalence has been reported to be higher (two studies), lower (one study) or no different (two studies) in organic compared to conventional pigs
- 5/5 studies indicate a higher percentage of organic pigs carrying antibodies against Toxoplasma gondii

(van Loo et al., 2012; Luecke, 2016)

Need to manage zonoses risks in extensive systems
Higher Product Quality

Nutritional value

few published studies comparing composition of organic and conventional pig meat (4-6 studies per parameter).

- no difference in total or intramuscular fat content
- concentrations of saturated fatty acids (health -) lower in organic pork [-3% daily consumption]
- concentrations of polyunsaturated fatty acids (health +) higher in organic pork [+14% daily consumption]
- concentrations of n-3 PUFA (health ++) higher in organic pork [+16% daily consumption]

(Srednicka-Tober et al., 2016)

Minerals and micronutrients
Higher Product Quality

Organoleptic characteristics

- no consistent objective evidence that the organoleptic quality and eating experience of pigmeat is improved by organic rearing
- many aspects of production which might be modified in organic systems have the potential to influence meat quality:
  use of traditional breeds, growth rate, carcass adiposity, choice of feed ingredients, pre-slaughter stress

(Edwards, 2005)

Strategies need to be developed
The Challenge of Boar Taint

• Organic production wishes to avoid mutilations, but castration is still the norm.
• Could organic systems use entire males?

VS
Boar taint in DK organic entire males

Resolution of dilemma needed

% carcasses (90-130 kg lwt) which would be rejected:
75.7% for androstenone (>1.0 µg/g)
9.8% for skatole (>0.25 µg/g)
18.3% with a positive human nose sensory evaluation

(Thomsen, 2015)
Higher Product Quality

- sensory evaluation of product quality can be influenced by cognitive factors (beliefs and attitudes) regarding consumers views on the production system

(Dransfield et al., 2005)
Higher Product Quality

**Perception of production methods**
- Maintain a strongly differentiated image
  - High animal welfare
  - Low environmental impact

http://www.farmhealthonline.com/health-welfare/pigs/pig-outdoor-access/
Does animal health, welfare and environmental impact of organic pigs differ between husbandry systems?

(Rudolph, 2015)
Indoor with outside run (IN)

Pregnant & lactating sows (SO)  Weaners (WE)  Fatteners (FA)

Outdoor system (OUT)
Animals, materials, methods

7 assessors in 8 countries
3 training sessions
2 inter-observer repeatability tests
one day visit / farm by one person
74 farms

Non-parametric Kruskal-Wallis tests, if $p < 0.05$ pairwise testing
(Wilcoxon rank sum; Bonferroni corrected) $p < 0.05$
Results I – Good welfare across systems

<table>
<thead>
<tr>
<th>Parameter</th>
<th>INDOOR (n=34)</th>
<th>POUT (n=28)</th>
<th>OUT (n=12)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ectoparasites SO, FA [%]</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>ns</td>
</tr>
<tr>
<td>Lameness FA [%]</td>
<td>0.7</td>
<td>0.7</td>
<td>0.0</td>
<td>ns</td>
</tr>
<tr>
<td>Tail lesions WE [%]</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>ns</td>
</tr>
<tr>
<td>Sick Pigs [%pen] WE; FA; SO</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>ns</td>
</tr>
</tbody>
</table>
## Results II – Disadvantages Indoors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>INDOOR (n=34)</th>
<th>POUT (n=28)</th>
<th>OUT (n=12)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lameness SO [%]</td>
<td>7.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.4&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.001</td>
</tr>
<tr>
<td>MMA treatment [%]</td>
<td>16.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.000</td>
</tr>
<tr>
<td>Resp. probl. FA [%pens]</td>
<td>66.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>60.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.002</td>
</tr>
<tr>
<td>Diarrhoea WE [%pens]</td>
<td>25.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.015</td>
</tr>
</tbody>
</table>
**Results III Improvement needed**

We have more knowledge: VIPiglet  
But improvements in practice still needed

<table>
<thead>
<tr>
<th>Parameter (median)</th>
<th>INDOOR (n=34)</th>
<th>POUT (n=28)</th>
<th>OUT (n=12)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total suckling piglet losses [%] (live+dead born)</td>
<td>21.3</td>
<td>21.6</td>
<td>19.2</td>
<td>ns</td>
</tr>
<tr>
<td>Prevalence per thousand (1DK abattoir, 2y, 1.1m pigs)</td>
<td>Conventional indoor</td>
<td>Conventional free range</td>
<td>Organic free range</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>---------------------</td>
<td>-------------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>Dead on arrival</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Unthrifty</td>
<td>0.4</td>
<td>0.7</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>Condemned</td>
<td>1.6</td>
<td>2.4</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>Respiratory lesion</td>
<td>225.2</td>
<td>209.8</td>
<td>177.7</td>
<td></td>
</tr>
<tr>
<td>Leg swelling</td>
<td>30.9</td>
<td>15.8</td>
<td>12.7</td>
<td></td>
</tr>
<tr>
<td>Abscess</td>
<td>30.2</td>
<td>37.4</td>
<td>33.6</td>
<td></td>
</tr>
<tr>
<td>Septicema</td>
<td>21.4</td>
<td>31.8</td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td>Hernia</td>
<td>12.1</td>
<td>9.6</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>Skin lesions</td>
<td>10.7</td>
<td>23.2</td>
<td>40.8</td>
<td></td>
</tr>
<tr>
<td>Hoof abscess</td>
<td>7.8</td>
<td>7.0</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>Tail lesion</td>
<td>7.1</td>
<td>29.3</td>
<td>21.0</td>
<td></td>
</tr>
<tr>
<td>Bone fracture</td>
<td>5.1</td>
<td>10.3</td>
<td>11.7</td>
<td></td>
</tr>
<tr>
<td>White spot liver</td>
<td>4.6</td>
<td>12.2</td>
<td>15.8</td>
<td></td>
</tr>
<tr>
<td>Arthritis</td>
<td>2.6</td>
<td>9.7</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Enteritis</td>
<td>0.8</td>
<td>0.7</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Kidney lesion</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

Improvements in practice still needed

(Kongsted & Sørensen, 2017)
Biosecurity in pasture systems

Difficult (?) impossible) to control wildlife contact

What happens if ASF becomes endemic in wild boar?
### Environmental Impact

**Functional unit 1kg LWT (except Williams – 1kg carcass wt)**

<table>
<thead>
<tr>
<th>Study</th>
<th>Greenhouse Gas Emissions</th>
<th>Acidification Potential</th>
<th>Eutrophication Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg CO2-eq</td>
<td>cf CON</td>
<td>g SO2-eq</td>
</tr>
<tr>
<td><strong>Williams et al (2006)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>5.6</td>
<td>-11%</td>
<td>129</td>
</tr>
<tr>
<td><strong>Basset-Mens et al (2005)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>4.0</td>
<td>+73%</td>
<td>37</td>
</tr>
<tr>
<td><strong>Halberg et al (2010)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>2.8-3.3</td>
<td>+7–22%</td>
<td>50 to 61</td>
</tr>
<tr>
<td><strong>Dourmad et al (2014)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 EU countries</td>
<td>2.4</td>
<td>+8%</td>
<td>57</td>
</tr>
<tr>
<td><strong>Kool et al (2015)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 EU countries</td>
<td>4.3-5.0</td>
<td>+14-26%</td>
<td></td>
</tr>
</tbody>
</table>

NB. Ranking of system impacts depends on which functional unit is used in a study. The degree of intensification was inversely proportional to environmental impacts expressed per kg of pig weight produced, but proportional when expressed per ha of land used.
### Results III – Pros & Cons

<table>
<thead>
<tr>
<th>Parameter</th>
<th>INDOOR (n=24)</th>
<th>POUT (n=307)</th>
<th>OUT (n=10)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse gas emissions</td>
<td>2.20</td>
<td>2.21</td>
<td>2.21</td>
<td>ns</td>
</tr>
<tr>
<td>Acidification potential</td>
<td>61.9</td>
<td>51.9</td>
<td>55.4</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>21.6</td>
<td>20.1</td>
<td>28.7</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

(Rudolph, 2015)
Environmental Impact

(Jakobsen et al., 2015)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Indoor</th>
<th>Pasture foraging</th>
<th>Lucerne /Artichokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenhouse Gas Emissions (kg CO2 eq/ per kg pig lwt)</td>
<td>3.69</td>
<td>3.68</td>
<td>3.12</td>
</tr>
<tr>
<td>Ammonia Emission (kgN/ha)</td>
<td>49</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>N leaching (kgN/ha)</td>
<td>99</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>Total N losses (kgN/ha)</td>
<td>144</td>
<td>135</td>
<td>141</td>
</tr>
</tbody>
</table>

GHG emissions also refer to contributions from soil C changes and indirect land use change

More studies with real data needed on rotations
Associations between welfare and environment?

Good % = % of welfare outcomes better than median score

(Rudolph, 2015)

BUT we know there are trade offs

Resolution of dilemma needed
Objectives for Organic Pigs

- **SUSTAINING A PROFITABLE MARKET**
  - focussing on product quality
  - maintaining high-welfare, environment-friendly image

- **INTEGRATING IN A SUSTAINABLE FARM SYSTEM**
  - implementing appropriate rotations
  - maximising nutrient utilisation

- **REDUCING PRODUCTION COST**
  - increasing output
  - improving feed efficiency
## Results IV – Production efficiency

<table>
<thead>
<tr>
<th>Parameter</th>
<th>INDOOR (n=23)</th>
<th>POUT (n=27)</th>
<th>OUT (n=10)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs weaned/sow/y</td>
<td>19.4</td>
<td>19.0</td>
<td>13.5</td>
<td>0.049</td>
</tr>
<tr>
<td>Finishing herd FCR</td>
<td>3.3</td>
<td>3.2</td>
<td>4.9</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

We have more knowledge: ICOPP
But efficiency improvements still needed in practice

(Rudolph, 2015)
High Animal Welfare

Future Challenges: (SUSTAINING A PROFITABLE MARKET)

- Justify a substantial market premium
  - Reliably higher product quality [healthiness, succulence, boar taint]
  - Maintain a strongly differentiated image
    - High animal welfare [CorePig, ProPig, mutilations]
    - Low environmental impact [integrated systems, nutrient surpluses, nutrient capture – theory to practice]

- Reduce cost of production
  - Improve feed efficiency [ICOPP]
  - Improve prolificacy [LowInputBreeds]
  - Reduce mortality [VIPiglet, POWER]
  - Use labour more efficiently [mechanisation]

- A reliable, current EU evidence base! [CorePig, ProPig, SusAn]
Where might we be?

The sector has 2 potentially conflicting challenges:

- Achieving a high product premium
- Growing the volume of meat sales

This is likely to lead to diversification of production strategy within the sector
ORGANIC PIG PRODUCTION
year 2030

Strategy 1 – high premium production

This requires very clear differentiation in all areas of consumer perception targeting an affluent and discerning consumer sector

- Enriched outdoor environment
- Mutilation free
- (local) breeds with good eating quality
- Aesthetically appealing!

Likely to require high focus marketing, lower slaughter weights, lower stocking rates, integration with wider ranging farm enterprises
ORGANIC PIG PRODUCTION
year 2030

Strategy 2 – high volume production (and sales!)

This requires a minimal price differential and a greater focus on primary quality attributes

- Efficient production with improved breeds
- More controlled environment, incl biosecurity
- Healthy and tasty product
- Scientifically ethical

Likely to require more sophisticated housing, specialist organic breed, low emission manure management, feeds for product characteristics
Acknowledgements

- Colleagues across Europe in:
  
  – CORE Organic I – CorePig
  https://www.coreorganic.org/core1/research/projects/corepig/index.html

  – CORE Organic II - ProPIG
  http://www.coreorganic2.org/coreorganic2.asp