IMPROVING PROTEIN EFFICIENCY OF LIVESTOCK

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ACKNOWLEDGEMENT

■ Breed4Food theme 4: Resource Efficiency

■ Project team
Alternative protein sources?  Livestock more efficient?
AIM

- To identify new traits related to protein efficiency of livestock
- Using
  - Desk study to investigate possibilities to breed for improved protein efficiency
DEFINITION PROTEIN EFFICIENCY

- **Corr. protein efficiency** = \( \frac{{\text{animal protein output (kg)}}}{{\text{human edible protein input (kg)}}} \times 100\% \)
- Corrected for human-edible proteins

<table>
<thead>
<tr>
<th>Feed</th>
<th>Human-edible proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazed pasture, silage and hay</td>
<td>0</td>
</tr>
<tr>
<td>Cereal and pulse grains</td>
<td>80</td>
</tr>
<tr>
<td>Cereal by-products</td>
<td>20</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>80</td>
</tr>
<tr>
<td>Other oilseed meals</td>
<td>20</td>
</tr>
<tr>
<td>Other by-products</td>
<td>20</td>
</tr>
<tr>
<td>Mineral vitamin premix</td>
<td>0</td>
</tr>
</tbody>
</table>
# Protein Efficiency of Livestock

<table>
<thead>
<tr>
<th>Species</th>
<th>PE (%)&lt;sup&gt;1&lt;/sup&gt;</th>
<th>CPE (%)&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigs</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>Broilers</td>
<td>33</td>
<td>48</td>
</tr>
<tr>
<td>Laying hens</td>
<td>31</td>
<td>43</td>
</tr>
<tr>
<td>Dairy cattle</td>
<td>18</td>
<td>143</td>
</tr>
</tbody>
</table>

<sup>1</sup> PE = Protein efficiency (Wilkinson, 2011),  
<sup>2</sup> CPE = Corrected protein efficiency (Wilkinson, 2011)  
Based on UK ration
AMBITION

- Corrected protein efficiency > 100%
  - To improve protein efficiency
  - To produce animal protein with no or hardly any human edible proteins
IMPROVE PROTEIN EFFICIENCY
PROTEIN SOURCES

Most important

Alternative protein sources:

- Perform well in the neighbourhood
- Cultivation is currently not common
- Economically feasible
- Future: still human-inedible
POTENTIAL ALTERNATIVES

**Oil seeds:** rapeseed, sunflower seed, defatted soybeans

**Grain legumes:** peas, *vicia faba*, lupines

**Forage legumes:** Lucerne

**Leaf proteins:** grass, sugar beet leaves

**Aquatic proteins:** algae, duckweed

**Insects:** mealworm, housefly

Van Krimpen et al., 2013
POTENTIAL ALTERNATIVES

Requirement of an animal

- Digestible amino acids

Cost price of alternative diet

- Leaf proteins: grass, sugar beet leaves
- Aquatic proteins: algae, duckweed
- Insects: mealworm, housefly
BREEDING

- So far, focus has been on feed efficiency using feed conversion ratio (FCR)
  - Especially improvement of performance (growth, egg number)
  - Pigs: 20% improvement in feed conversion ratio (‘30-’90)
  - Laying hens: 30% improvement in feed conversion efficiency (‘50-’93)

Hill, 2008
GROWTH BROILERS 1957 VS 2001

Body weight (kg) vs Age in weeks

- Blue bars: pop '01, diet '01
- Red bars: pop '01, diet '57
- Green bars: pop '57, diet '01
- Purple bars: pop '57, diet '57

Havenstein et al., 2003

Protein efficiency 29-08-2016
GROWTH BROILERS 1957 VS 2001

Body weight (kg)

Age in weeks

- pop '01, diet '01
- pop '01, diet '57
- pop '57, diet '01
- pop '57, diet '57

Breeding

Havenstein et al., 2003
BREEDING FOR PROTEIN EFFICIENCY

Trait definition

- Often protein input/output unknown
- Direct – advanced measurements needed
- Indirect
  - Feed conversion ratio
  - Manure
INTERACTION NUTRITIONISTS & BREEDERS

- Genotype x Nutrition interaction
- Precision feeding
- Nutrigenomics
- Digestibility
- Partitioning
- Health status
RECOMMENDATIONS

- Use a diet that fits the requirement of the animal
- Breed an animal that can produce on the future diet

Interaction between nutritionists and breeders is important!
TAKE HOME MESSAGE

- Breed an animal that can produce on the future diet!

- Share data
  - Collect individual data
  - Genotype is known

- Future collaboration