Innovations in Animal Feed (Additives)

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Innovation Director
Fundamental understanding of nutritional processes and the effects on the health, growth, welfare and longevity of animals.

Animal Nutrition group of Wageningen University
What needs to happen for antibiotic (growth promoter) free production

- Nutrition
- Gut & Immune Function
- Hygiene
- Microbiome

Image: Ted
Feed structure – better organ development

100% diet
Grinding
15% whole grain
Pelleting

Experimental group
Control (starconcept 0%)
Trial (starconcept 15%)

- Similar feed conversion
- Better stomach function
- Less prone to Salmonella infections

Adding a few % fiber structure to a broiler diet

Reviews
The gizzard: function, influence of diet structure and effects on nutrient availability

B.SVIHUS
Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, World's Poultry Science Journal, Vol. 67, June 2011

- Better organ development
- Beneficial for ‘right flora in the right place’
- Same or better feed conversion
Less overfeeding of protein

- Protein digestion is generally 60-90%
- Younger animals have generally lower digestibility
- Raw material quality also varies in practice

All the protein that is not digested in the small intestine is potentially fermented by pathogens in the large intestine

### Table 1.1. Protein content and protein digestibility of commonly used feed ingredients in pig and broiler diets.

<table>
<thead>
<tr>
<th>Feed ingredient</th>
<th>Protein content (g/kg)</th>
<th>Digestibility (%)&lt;sup&gt;1&lt;/sup&gt; Pig</th>
<th>Digestibility (%)&lt;sup&gt;1&lt;/sup&gt; Broiler</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SID, AID</td>
<td>SID, ATTD</td>
</tr>
<tr>
<td>Cereal grains</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>64 - 88</td>
<td>82, 69</td>
<td>90, 83</td>
</tr>
<tr>
<td>Wheat</td>
<td>85 - 139</td>
<td>89, 80</td>
<td>88, 81</td>
</tr>
<tr>
<td>Barley</td>
<td>76 - 124</td>
<td>80, 70</td>
<td>90, 70</td>
</tr>
<tr>
<td>Rice</td>
<td>69 - 87</td>
<td>95, 82</td>
<td>- 82</td>
</tr>
<tr>
<td>Sorghum</td>
<td>66 - 108</td>
<td>84, 73</td>
<td>86, 76</td>
</tr>
<tr>
<td>Oat</td>
<td>66 - 138</td>
<td>76, 66</td>
<td>- 75</td>
</tr>
<tr>
<td>Plant protein sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pea</td>
<td>170 - 236</td>
<td>79, 74</td>
<td>76, 87</td>
</tr>
<tr>
<td>Lupins</td>
<td>284- 440</td>
<td>87, 84</td>
<td>86, 90</td>
</tr>
<tr>
<td>Soybean meal (fibre &lt; 4.5 %)</td>
<td>438 - 498</td>
<td>88, 85</td>
<td>90, 87</td>
</tr>
<tr>
<td>Soybean meal (fibre &gt; 4.5 %)</td>
<td>390 - 495</td>
<td>86, 88</td>
<td>- 85</td>
</tr>
<tr>
<td>Rapeseed meal</td>
<td>308 - 403</td>
<td>72, 70</td>
<td>76, 76</td>
</tr>
<tr>
<td>Sunflower meal</td>
<td>324 - 438</td>
<td>80, 78</td>
<td>84, 85</td>
</tr>
<tr>
<td>DDGS-maize</td>
<td>238 - 292</td>
<td>73, 69</td>
<td>- -</td>
</tr>
<tr>
<td>DDGS-wheat</td>
<td>246 - 402</td>
<td>77, 74</td>
<td>- -</td>
</tr>
<tr>
<td>Animal protein sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish meal</td>
<td>506 - 749</td>
<td>85, 83</td>
<td>80, 88</td>
</tr>
<tr>
<td>Meat bone meal</td>
<td>413 - 497</td>
<td>59, 57</td>
<td>65, 73</td>
</tr>
</tbody>
</table>

<sup>1</sup> SID= standardized ileal digestibility; AID= apparent ileal digestibility; ATTD= apparent total tract digestibility. Reference: Lemme et al. (2004); CVB (2016)
Hydrolytic enzymes improve (protein) digestibility

- Phytases are the most commonly used enzyme, globally
- Competition drives increased efficacy & reduced costs → higher inclusion levels

Other enzymes used in animal production: xylanases, beta-glucanases, amylases, proteases
DFM / probiotic maintain general gastrointestinal health

- **Stimulate defense by host**
- **Competitive exclusion**
  - Compete for nutrients
  - Compete for ecological niches
- **Stimulate immune response**
- **Immuuno modulation**
  - Regulate proinflammatory cytokines
- **Enhance beneficial microbiota**
  - Inhibition of virulence factors
- **Decrease luminal pH**
- **Direct microbial interactions**
- **Secrete bacteriocidal molecules**
- **Cr vIt Se Fe**
- **Decrease luminal pH**
- **Regulate proinflammatory cytokines**
- **Enhance beneficial microbiota**

What are DFM / probiotics capable of?

**Probiotics can**
- Support the development of a healthy gut (immune system, gut function and microbiota development)
- Support the recovery post-infection
- Can have antimicrobial activity against other microbes (typically broad spectrum)
- Add to the overall fermentation and can produce beneficial metabolites

**Probiotics are**
- NOT a drug
- NOT a true replacement for therapeutic antibiotics
Innovations in Animal Feed (Additives)

- A combination of feed additives and feeding more precisely can reduce the need of antibiotics drastically (EU and market examples).
- Further antibiotic reduction needs the development of more consistent feed additive solutions.
- Key is increasing the robustness of the animals.
- We should conserve the efficacy of antibiotics for when they are really needed when animals despite all measures become sick (animal welfare).