Summary of Research into Animal Gut Health

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Agenda
1. Feeding the Future
2. Antimicrobial resistance
3. Working together in an integrated approach
4. Research proves its worth
5. Take home message

Opportunities & challenges
On average worldwide the productivity of farm animals is 30-40% below their genetic potential because of suboptimal conditions and health status.

2. Antimicrobial resistance
Today close to 1 million people die due to antibiotic resistance; by 2050 it will be the main death cause.
64.45% decline in antibiotic sales in the Netherlands (2009-2016)

A ban on Antimicrobial Growth Promoters (AGPs) doesn’t automatically reduce antibiotic use; ambitious targets in combination with multi-stakeholder commitment is pivotal.

Antibiotic resistance is reversible

Reducing the use of antibiotics pays off: multi-resistance of E.coli in the Netherlands decreases.

3. Working together in an integrated approach

A drastic reduction of antibiotic in food production can be achieved if we move to a new farming model based on holistic and multi-stakeholder collaboration.

Robust animals due to genetic development
Effective vaccines supporting strong immune system
Healthy nutrition resulting in healthy animals
Improved hygiene and safety at farm level

4. Research proves its worth

Steering intestinal health

4 level strategy for animal protection
1. Prevent pathogen intake
2. Microbiota management
3. Improve gut integrity
4. Immunomodulation
**Toolkit of feed additives to combine for the desired effect**

<table>
<thead>
<tr>
<th>Formic</th>
<th>Propionic Addict</th>
<th>Lactic Acid</th>
<th>Medium Chain Fatty Acids (MCFA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butyrate</td>
<td>Controlled release</td>
<td>Butyrate</td>
<td></td>
</tr>
<tr>
<td>Phenolic compounds</td>
<td>Specific plant extracts as source</td>
<td>Specific plant extracts as source</td>
<td></td>
</tr>
</tbody>
</table>

**Targeted effects**
- Activity bacteria ↓, balance microbiota
- Tumour epithelial cells, mucus ↑
- Immune modulation
- Turnover epithelial cells, mucus ↑

**Form**
- Mixture of MCFA derived from plant oils

**Semi-high throughput in vitro methods to prescreen**

**Efficacy of feed candidates on microbiota, mucosal barrier and immunity**

**In vitro screening methods**
- Microbial activity screen
- Cell integrity screen
- Immune modulation screen

**50-100 Candidates**
- In Vivo Proof of Efficacy

**Functional additives support the animal's gut health**

A combination of functional feed additives to balance the microbiota and support the mucosal barrier function.

**General disease resistance and pathogen-specific approaches can be followed in nutrition**

**Level 1**
- Stabilisation microbiota
- Strengthen gut barrier function

**Proprietary blend based on SCFA, MCFA restored microbial diversity post-weaning and increased abundance in butyrogenic microbes**

**Domain Phylum-Class-Order-Family-Genus-Species**
- Clostridium
- Aminobacterium
- Ruminococcus

Source: Trouw Nutrition R&D, NIZO Food Research
Feed additives modulate piglets intestinal microbiota

Con = Control, Aur = Aureomycin/Chlortetracyclin, PreX = SCFA, MCFA, phenolic based blend (Presan), PxFP = PreX + Organic acid blend (Presan and Fysal)

Phylum

Ruminococcus

Con  Aur  PreX  PxFP

Family

Aureococcaceae

Con  Aur  PreX  PxFP

Genus

Lactobacillus

Con  Aur  PreX  PxFP

Faecalibacterium

Con  Aur  PreX  PxFP

Drinking water acidifier (DWA) improved performance in broiler chickens housed in either clean or low hygiene conditions

Daily weight gain (g/day)

Source: Roubos et al., 2017

Level 2

Salmonella

Campylobacter

Pathogen specific approaches

Attacking Salmonella from different angles

Metabolism ↓

Membrane function ↓

Beneficial bacteria ↑

Mucus secretion ↑

IgA secretion ↑

Administration of water acidifier reduced shedding of Salmonella in piglets and lowered number Salmonella positive pigs in field study

<table>
<thead>
<tr>
<th>Herd number (treatment)</th>
<th>Control % Positive</th>
<th>Water Acidifier % Positive</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (119)</td>
<td>21.8%</td>
<td>8.4%</td>
<td>p&lt;0.10</td>
</tr>
<tr>
<td>B (140)</td>
<td>27.1%</td>
<td>20.7%</td>
<td>p&lt;0.10</td>
</tr>
<tr>
<td>C (240)</td>
<td>58.3%</td>
<td>12.3%</td>
<td>p&lt;0.001</td>
</tr>
</tbody>
</table>

Positive = cut-off OD%>10
* Applied 25 to 115 kg, dose range 0.15 – 0.20%

Mannobiose reduced shedding of Salmonella Typhimurium in challenged piglets

Plant derived mannobiose: non-digestible, soluble oligosaccharide

Source: Trouw Nutrition R&D, 2015

Source: Trouw Nutrition R&D, 2015
Organic acids, MCFA and mannobiose had additive effect on reducing diarrhoea incidence in piglets

Diarrhoea incidence was significantly decreased in the piglets fed MCFA and MCM (contains mannobiose) diet when compared to control and OA diet in sub-optimized hygiene and climate conditions for week 1 to 5 post weaning.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Feed Efficiency (kg gain/kg feed intake)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.75a</td>
</tr>
<tr>
<td>OA</td>
<td>0.78ab</td>
</tr>
<tr>
<td>OA + MCFA</td>
<td>0.79b</td>
</tr>
<tr>
<td>OA + MCFA + MCM</td>
<td>0.77ab</td>
</tr>
</tbody>
</table>

Source: Trouw Nutrition R&D

5. Take home message

Facing the challenge. Together.
We can reduce antibiotic use in food production globally, by applying Feed-Farm-Health management strategies.

- Optimal farm management
- Healthy nutrition and functional feed additives
- Optimal health management

Thank you