Effect of alternative feed additives to medicinal zinc on the productivity, diarrhoea incidence and gut development in weaned pigs

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Remedies

- Antibiotics
  - Resistance

- Zinc oxide (within 5 yrs)
  - Environmental
  - Co-selection for MRSA

Potential alternatives
- Probiotics
- Prebiotics
- Enzymes
- Essential oils
- Organic acids
- Seaweeds

Our focus
- 2500 to 1500 ppm ZnO
- Other alternatives (MG, GP & OFS)
Objectives

Can dietary ZnO be reduced from 2500 to 1500 ppm ZnO?
   - 40% reduction in release
   - But efficacy and production data – not available

Can other alternatives substitute ZnO?

• **Oceanfeed™ Swine** (macroalgae product; OFS)
  - Contains array of bioactive compounds

• **Miya-Gold®** (probiotic; MG)
  - Feed additive with spore of *Clostridium butyricum*

• **GærPlus** (synbiotics; GP)
  - Consists of probiotics (*Bacillus Licheniformis* & *Subtilis*) and the prebiotics (mannan oligosaccharides and β-glucans derived from yeast cell wall)
Experimental design and animals

- Grønhøj Experimental Station, 15 July 2016 to 15 February 2017
- 4,680 piglets from weaning to 35 days of age
  - 180 piglets inserted per week
- BW at insertion: 7± 0.25 kg (no difference among groups), BW at exit: 30 kg
- Six dietary treatments: 2500 ppm ZnO, 1500 ppm ZnO, 0 ZnO, OFS, MG and GP
- Subgroup of 15 piglets/treatment slaughtered D11 after weaning
  - Body proportions
  - Weight of tissue and contents of different segments of the gastrointestinal tract
- Postweaning diarrhea (PWD) treatments
  - First 2 pigs with diarrhea: individually treated
  - 3 or more cases: entire flock (pen) treated
## Dietary treatments

<table>
<thead>
<tr>
<th>Feeding Phase:</th>
<th>2,500 Zn</th>
<th>1,500 Zn</th>
<th>0 Zn</th>
<th>OFS</th>
<th>MG</th>
<th>GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1 (d 0 to 11, 7-9 kg)</td>
<td>2,500 Zn</td>
<td>1,500 Zn</td>
<td>0 Zn</td>
<td>1.5%</td>
<td>2 kg / ton</td>
<td>0.5 kg / ton</td>
</tr>
<tr>
<td>Phase 2 (d 12 to 27, 9-15 kg)</td>
<td>0 Zn</td>
<td>0 Zn</td>
<td>0 Zn</td>
<td>1.5%</td>
<td>1 kg / ton</td>
<td>0.5 kg / ton</td>
</tr>
<tr>
<td>Phase 3 (d 28 to 52, 15-30 kg)</td>
<td>0 Zn</td>
<td>0 Zn</td>
<td>0 Zn</td>
<td>1.5%</td>
<td>0.5 kg / ton</td>
<td>0.25 kg / ton</td>
</tr>
</tbody>
</table>
## Results: Piglet performance

<table>
<thead>
<tr>
<th>Group</th>
<th>2,500 Zn</th>
<th>1,500 Zn</th>
<th>0 Zn</th>
<th>OF</th>
<th>MG</th>
<th>GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1, d 0 to 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>ADFI</td>
<td>0.31&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.29&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.26&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.26&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>ADG</td>
<td>222&lt;sup&gt;a&lt;/sup&gt;</td>
<td>207&lt;sup&gt;b&lt;/sup&gt;</td>
<td>153&lt;sup&gt;b&lt;/sup&gt;</td>
<td>164&lt;sup&gt;b&lt;/sup&gt;</td>
<td>153&lt;sup&gt;b&lt;/sup&gt;</td>
<td>156&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>FCR</td>
<td>1.40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.44&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.68&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.62&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.72&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.71&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Phase 2, d 12 to 27</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ADFI/ADG/FCR</td>
<td></td>
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<td></td>
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<tr>
<td>No significant difference</td>
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<tr>
<td>Total period, d 0 to 52 (BW at exit = 30 kg)</td>
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<td></td>
</tr>
<tr>
<td>ADFI</td>
<td>0.88&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.87&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.85&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.86&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.86&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.86&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>ADG</td>
<td>523&lt;sup&gt;a&lt;/sup&gt;</td>
<td>520&lt;sup&gt;a&lt;/sup&gt;</td>
<td>502&lt;sup&gt;b&lt;/sup&gt;</td>
<td>502&lt;sup&gt;b&lt;/sup&gt;</td>
<td>503&lt;sup&gt;b&lt;/sup&gt;</td>
<td>501&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>FCR</td>
<td>1.68&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.70&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.71&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.71&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
Result: occurrence and treatment of PWD in piglets

Figure 1. Cumulative percentage of group treated pens from different dietary treatment groups
Results: Effect on body proportions (slaughtered piglets D11 after weaning)

- No differences among treatments for (p>0.05):
  - Body proportions
    (body length, girth circumference, height over withers, head width)
  - Stomach and small intestinal tissue weight and weight of their contents
  - Blood haematological parameters

- Hind gut tissue weight (140 g) and weight of hind gut contents (147 g) were markedly reduced in OFS fed piglets compared to all other groups
  - Particularly relative to 2500 Zn group (173 and 226 g, respectively)
Conclusion

• Can the alternative supplements tested substitute ZnO in diarrhea prevention? **No!** The tested macroalgae, probiotic and synbiotic products could not:
  – Reduce diarrhea outbreaks compared to 0 Zn fed piglets
  – Improve production parameters (ADG, FI and FCR) above the 0Zn fed piglets

• Can ZnO supplementation be reduced from 2500 to 1500 ppm without compromising piglet health and performance? **Yes!** The reduction did not impact ADFI, ADG or FCR over the entire post-weaning period
  • 1500 ppm ZnO postponed onset of diarrhea during the early sensitive phase of weaning almost as efficiently as 2500 ppm ZnO

• The macroalgae product, OFS, reduced hind gut development
  • Agrees with antimicrobial effect => reduce butyrate production ? (growth factor for hind gut)
  • But clearly not selective towards pathogenic bacteria
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