ACIDIFYING FEEDING OF FINISHER PIGS

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Abstract #18897: Effect of benzoic acid and calcium chloride on microbiota, mineral balance and bone in growing pigs. EAAP Annual Meeting 2014, Copenhagen, Denmark
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BACKGROUND

- Benzoic acid (BA) in pig diets
  - Approved in EU as a feed supplement to reduce acidity of slurry
  - We have worked on BA in several projects
  - BA reduces pH of urine and slurry and NH₃ emissions during storage
  - BA is efficiently converted into hippuric acid and excreted
  - Results in small but significant reductions in blood pH
  - No/small BA effect on P and Ca balances in short studies

- Next question to ask
  - Any long-term effects of BA on mineral balance and bone strength?

- Benzoic acid (VevoVitall® from DSM)
HYPOTHESES

› BA can be used to lower urine pH
› By reducing the dietary electrolyte balance (dEB), urine pH will be lower
› (dEB ≈ DCAD ≈ Na⁺ + K⁺ - Cl⁻ in meq/kg DM)
› Replacing CaCO₃ by CaCl₂ → lower dEB
› Acidifying feed → lower urine pH → lower slurry pH → lower NH₃ emission during storage
› Both BA and CaCl₂ make up a risk of metabolic acidosis + mobilization of bone minerals to buffer blood pH
› In the longer term, BA and CaCl₂ reduce bone strength
CONCEPTS OF TREATMENTS

- 4 diets in two-factorial design
- +/- 1% BA
- Ca from either CaCO$_3$ or CaCl$_2$

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>+Benzoic acid</th>
<th>Low dEB</th>
<th>Low dEB +Benzoic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>-BA/+CaCO$_3$</td>
<td>+BA/+CaCO$_3$</td>
<td>-BA/+CaCl$_2$</td>
<td>+BA/CaCl$_2$</td>
<td></td>
</tr>
<tr>
<td>14 g/kg CaCO$_3$</td>
<td>14 g/kg CaCO$_3$</td>
<td>20 g/kg CaCl$_2$</td>
<td>20 g/kg CaCl$_2$</td>
<td></td>
</tr>
<tr>
<td>0 g/kg BA</td>
<td>10g/kg BA</td>
<td>0 g/kg BA</td>
<td>10g/kg BA</td>
<td></td>
</tr>
</tbody>
</table>
PROTOCOL

› 24 female pigs
› Duration from 36 – 113 kg
› Housed individually
› Ad libitum feeding
› Metabolism crates from 60-66 kg
› P and Ca balances
› Slaughter at 113 kg
› Digesta collected
› pH, organic acids
› Metacarpal bones dissected
› CT-scanning, mineral analysis etc.
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BROAD RESEARCH TEAM

› Ole Højberg
  › Evaluation of organic acids in digesta
› Juan M.S. Medina
  › CT scanning
› Jørgen Eriksen
  › Environmental impact
› Jan V. Nørgaard
  › Mineral balance
RESULTS

› Urine pH
  › Reduced by both treatments
  › From pH 8.2 to 6.2

› Slurry storage
  › pH reduced by 0.4-0.6 units
  › NH₃ emission reduced by 28-40%
RESULTS

› Digesta samples
  › Stomach
  › Small intestine
  › Caecum
  › Colon
› Neither BA nor Ca source reduced pH and conc. or organic acids significantly
› Microbial activity was not affected
RESULTS

› P and Ca balances were affected by neither BA nor by replacing CaCO\(_3\) with CaCl\(_2\) ...

› But the combined effect (+BA/CaCl\(_2\)) reduced apparent P and Ca digestibility and retention
RESULTS

› Metacarpal III bones
  › Weight and length was reduced by CaCl₂ but not by BA
  › Ash and P reduced by both treatments
  › Mineral density (mg/cm³) was reduced by both treatments
CONCLUSIONS

- Urine pH, slurry pH, and NH₃ emission were reduced by BA and by replacing CaCO₃ with CaCl₂
- GI-tract pH and microbial organic acids (activity) were not affected
- P and Ca apparent digestibility and retention were reduced by the combined effect of BA and replacement of CaCO₃ with CaCl₂
- Mineral density of metacarpal III bones was reduced both by BA and by replacing CaCO₃ with CaCl₂
- BA and CaCl₂ are not considered to affect bone strength severely, but their combined effect may reduce bone strength during long-term feeding
Thank you!

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Just accepted: Eriksen et al., part on emissions from slurry. J. Environ. Qual.