Sodium benzoate - a promising acidifier for pigs and poultry

Dr. Li Li, Technical Manager, Kemira Asia Pacific, Singapore
Introduction

1. Features of benzoate
   - **Feed safety aspects** - Anti-microbial activity
   - **Animal health and environmental benefits** - Metabolic fate of benzoate

2. The impact of sodium benzoate in combination with other organic acids (**Kemira Pro GIT SB5**) on animal performance
   - Pigs
   - Broilers
Benzoic acid, sodium benzoate

- pKa = 4.2
- Most active against yeasts, moulds, gram-positive and negative bacteria
- Acid form relatively insoluble, pungent smell and dusty
- Sodium benzoate tastes sweet and salty, highly soluble, user friendly
Feed safety aspects

Benzoic acids targets both gram negative and gram positive bacteria and coliforms, especially E. coli.

Antimicrobial spectrum of benzoic acid against selected microorganisms

<table>
<thead>
<tr>
<th>Microorganisms</th>
<th>pH of growth medium</th>
<th>MIC (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>5.2-5.6</td>
<td>50-120</td>
</tr>
<tr>
<td>Bacillus cereus</td>
<td>6.3</td>
<td>500</td>
</tr>
<tr>
<td>Listeria monocytogenes</td>
<td>5.6 (21 °C)</td>
<td>3000</td>
</tr>
<tr>
<td>Lactobacillus spp.</td>
<td>4.3-6.0</td>
<td>300-1800</td>
</tr>
<tr>
<td>Pseudomonas spp.</td>
<td>6</td>
<td>200-480</td>
</tr>
<tr>
<td>Candida krusei</td>
<td></td>
<td>300-700</td>
</tr>
<tr>
<td>Aspergillus niger</td>
<td>5</td>
<td>2000</td>
</tr>
</tbody>
</table>
Animal health and environmental benefits

**Metabolic fate of benzoate**
- Absorbed much slower than other organic acids
  - Considerate amount detected in the lower part of GI tract
- Metabolised in the liver and converted to hippuric acid
- Hippuric acid and benzoic acid excreted in the urine
  - Reduce urinary pH by 0.7 unit
  - Reduce ammonia emission into the atmosphere by 30%

**Benzoic acid has anti-agalactic property in sows**
- Prevent bacteriuria of the urinary tract and the reproductive organs after farrowing
Impact of different combinations and concentrations of acids on the growth of *E. coli* K88

**Graph:**
- **Y-axis:** OD at 595 nm
- **X-axis:** Time (hrs)
- **Lines:**
  - FA0.15
  - SB0.15
  - FA/SB0.15
  - Control
**Short chain organic acids at a glance – synergetic effects**

<table>
<thead>
<tr>
<th>Type of acid</th>
<th>Pka</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fumaric acid</td>
<td>3.02/4.32</td>
<td>✔ Reducing diet and stomach pH</td>
</tr>
<tr>
<td>Citric acid</td>
<td>3.10/4.80/6.40</td>
<td>✔ Reduce diet buffer capacity</td>
</tr>
<tr>
<td><strong>Formic acid</strong></td>
<td><strong>3.75</strong></td>
<td>✔ Antimicrobial effect</td>
</tr>
<tr>
<td>Lactic acid</td>
<td><strong>3.86</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Benzoic acid</strong></td>
<td><strong>4.19</strong></td>
<td>✔ Antimicrobial effect</td>
</tr>
<tr>
<td>Sorbic acid</td>
<td>4.80</td>
<td>✔ Improve gut health</td>
</tr>
<tr>
<td>Butyric acid</td>
<td>4.82</td>
<td>✔ Improve feed intake</td>
</tr>
<tr>
<td>Propionic acid</td>
<td>4.86</td>
<td></td>
</tr>
</tbody>
</table>
Kemira Pro GIT SB5 – product features

1. Synergetic combination of sodium benzoate and other organic acids
2. Small particle size, suitable for premixes
3. Excellent solubility, very suitable for liquid feeding system
4. No smell
5. No taste aversion
Experimental trials in pigs

Antibiotics free feeding regime:

✓ Trial 1 – Benzoic acid vs. KPG SB5
✓ Trial 2 – KPG SB5 in pigs challenged with E.coli endotoxin

On top of antibiotics

✓ Trial 3 – KPG SB5 dose response
✓ Trial 4 – Replacing zinc oxide
Kemira Pro GIT SB5 (sodium benzoate based acidifier)

- No taste-aversion
- Increase external surface area of jejunum and ileum.
- Decrease in faecal counts of Coliform bacteria
  - Boost performance after weaning
  - Increase the barrier function of the gut wall possibly by inhibiting bacterial pressure (E. coli) on it
- Increase average daily gain by 7%
- Improve FCR by 5%
Experimental trials in broilers

Trial 1 – KPG SB5 on top of antibiotics
Trial 2 – KPG SB5 replacing antibiotics
Acknowledgements

✓ to all the groups involved in sustainable and environmental friendly animal nutrition research