Effects of antibiotics on growth performance, diarrhea, and bacterial translocation in weanling pigs experimentally infected with a pathogenic *E. coli*

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Outline

➢ Challenges in pig industry
➢ Antibiotic growth promoter & side effects
➢ Hypothesis & Objective
➢ Results and conclusions
Growth in global protein demand

Source: Food and Agriculture Organization of the United Nations, ESA Working Paper No. 12-03, p. 131
Weaning stress

- Environmental changes
- Abrupt transition of diet
- Transportation stress
- Increased exposure to pathogens
Post weaning diarrhea in pigs

➢ One of the most serious threats for the swine industry

➢ Usually associated with proliferation of enterotoxigenic

\[ \text{E. coli (ETEC)} \]

➢ F4 (K88) or F18
Post-weaning *E. coli* diarrhea morbidity

Post-weaning *E. coli* diarrhea

- Ingestion of *E. coli*
- Attachment of *E. coli* to receptors through fimbriae
- Colonization and release of toxins
- Increase gut permeability (water and electrolytes into intestine)
- Diarrhea

Intestinal epithelial cells
Antibiotic growth promoters (AGPs) in diets

➢ A medicine that inhibits the growth of or destroys microorganisms

• Growth promotion
• Disease prevention
• Disease treatment

Source: http://mbioblog.asm.org
Efficacy of antibiotics as growth promoters for weaned pigs (7-25 kg)

Zimmerman, 1986
Side effects of antibiotics

➢ Development of resistant strains of pathogenic organisms

➢ Adverse or toxic reactions

➢ Increased susceptibility to infections

How does antibiotic resistance occur?

- Lots of germs and some are drug resistant.
- Antibiotics kill the bacteria causing the illness as well as the good bacteria protecting the body from infection.
- The drug resistant bacteria is now able to grow and take over.
- Some bacteria give their drug resistance to other bacteria.

- Normal bacterium
- Resistant bacterium
- Dead bacterium
Adverse effects by low-dose AGP

Subinhibitory antibiotics concentration

Enhancing bacterial selection for antibiotic resistance genes

Increasing antibiotic resistance

Barbosa and Levy, 2000; Smith et al., 2002; Barlow, 2009; Brewer et al., 2013, Looft et al., 2014
How antibiotic resistance can spread?
Hypothesis

Exposure to potential antibiotic resistance determinants or antibiotic residues exacerbates the infection of pigs.

https://www.foodsafetynews.com/international-targets-recommended-for-reducing-animal-antibiotic-use
Investigate the effects of very low-dose antibiotics on growth performance, diarrhea, fecal β-hemolytic coliforms, and bacterial translocation of weaned pigs experimentally infected with F18 *E. coli*.
Experimental design & treatments

- Experimental design: RCBD (Blocks: BW x Sex)
- 34 weaning pigs (6.88 ± 1.03 kg BW, 21 d old)
- Treatment: 3 treatments (11-12 pigs/treatment)

<table>
<thead>
<tr>
<th>CON (Control diet)</th>
<th>Low dose AGP</th>
<th>Control diet + 0.5 mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High dose AGP</td>
<td>Control diet + 50 mg/kg</td>
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</table>

*E. coli* challenged
Pathogenic F18 *E. coli* challenge (LT, STb, SLT-2); oral inoculation, $10^{10}$ cfu/dose with 3 doses

- Growth performance
- Daily diarrhea score
- β-hemolytic coliforms in feces

*Pl = post-inoculation
β-hemolytic coliforms & *E. coli* in feces

Blood agar

MacConkey agar
Data collection cont.

➢ Bacterial translocation in mesenteric lymph nodes

Plate homogenized lymph nodes to blood agar

➢ All data were analyzed by ANOVA using the PROC MIXED of SAS
Body weight

- CON
- Low AGP
- High AGP

<table>
<thead>
<tr>
<th>d 0</th>
<th>d 5 PI</th>
<th>d 11 PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ab</td>
<td>b</td>
<td>a</td>
</tr>
<tr>
<td>b</td>
<td>b</td>
<td>a</td>
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</tbody>
</table>
Average daily gain

- **CON**
- **Low AGP**
- **High AGP**

The graph shows the average daily gain from day 0 to 5 PI for different groups, with the High AGP group having the highest gain, followed by the CON group, and then the Low AGP group.
Diarrhea score

Diarrhea score

- **CON**
- **Low AGP**
- **High AGP**
β-hemolytic coliforms in feces

CON  Low AGP  High AGP

% 

d 2 PI  d 5 PI  d 8  d 11 PI

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Bacterial translocation in mesenteric lymph node

![Graph showing bacterial translocation in CON, Low AGP, and High AGP groups at d 11 PI.]

- CON
- Low AGP
- High AGP

Legend:
- CON
- Low AGP
- High AGP

Y-axis: cfu/g
X-axis: d 11 PI

Key points:
- CON group has lower cfu/g compared to Low AGP and High AGP groups.
- Low AGP group has significantly higher cfu/g compared to CON and High AGP groups.
- High AGP group has lower cfu/g compared to Low AGP group.

Annotations:
- a indicates significant difference compared to CON group.
- b indicates significant difference compared to High AGP group.

Note:
- ab indicates a trend between Low AGP and CON groups.
Conclusions

Very low-dose antibiotic growth promoter supplementation

✓ Exacerbated growth performance
✓ Exacerbated diarrhea
✓ Delayed reduction of β-hemolytic coliforms
✓ Increased bacterial translocation

of weaned pigs experimentally infected with F18 *E. coli*. 
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Thank you for your attention!