Effects of antibiotics on blood profiles in weanling pigs experimentally infected with a pathogenic *E. coli*

Kwangwook Kim¹, Yijie He¹, Cynthia Jinno¹, Seijoo Yang¹, Minho Song², Peng Ji¹, Yanhong Liu¹

¹University of California, Davis, CA,
²Chungnam National University, Daejeon, Republic of Korea
Outline

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

- **Beef:**
  - 2005: 64 million tonnes
  - 2050: 106 million tonnes

- **Pork:**
  - 2005: 100 million tonnes
  - 2050: 143 million tonnes

- **Poultry:**
  - 2005: 82 million tonnes
  - 2050: 181 million tonnes

- **Eggs:**
  - 2005: 62 million tonnes
  - 2050: 102 million tonnes

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

Weaning stress
Post weaning diarrhea in pigs

➢ One of the most serious threats for the swine industry

➢ Usually associated with proliferation of enterotoxigenic

  *E. coli* (ETEC)

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

![Graph showing the percentage of sites affected by *E. coli* diarrhea from 2000 to 2012.]

- 2000
- 2006
- 2012

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)

Intestinal epithelial cells

Diarrhea

= *E. coli*

= Toxin
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

https://ducu59us/Shutterstock.com
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 inflammation of pigs.

https://www.foodsafetynews.com/international-targets-recommended-for-reducing-animal-antibiotic-use
Previous results

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.*
Investigate the effects of very low-dose antibiotics on blood profiles and serum inflammatory mediators 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>
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<tbody>
<tr>
<td>Low dose AGP</td>
</tr>
<tr>
<td>Control diet + 0.5 mg/kg</td>
</tr>
<tr>
<td>High dose AGP</td>
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<tr>
<td>Control diet + 50 mg/kg</td>
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E. coli challenged
Experimental timeline & data collection

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

- Blood profiles
  - (WBC, RBC profiles)

- Serum inflammatory mediators
  - (TNF-α, C-reactive protein, Haptoglobin)

*PI=post-inoculation
Monocytes

- CON
- Low AGP
- High AGP

$10^3/\mu L$


d 0

d 2 PI

d 5 PI

d 11 PI
Packed cell volume

- CON
- Low AGP
- High AGP

% 50
40
30
20
10
0
d 0
d 2 PI
d 5 PI
d 11 PI
Mean corpuscular hemoglobin concentration (MCHC)

- CON
- Low AGP
- High AGP

- d 0
- d 2 PI
- d 5 PI
- d 11 PI

fL^2
C-reactive protein

μg/mL

CON  Low AGP  High AGP

d 0  d 2 PI  d 5 PI  d 11 PI

b  ab  a  ab  b  b

0  10  20  30
Conclusions

Very low-dose antibiotic growth promoter supplementation

✓ Exacerbated systemic inflammation
✓ 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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