

# **Dietary supplementation of botanicals enhanced growth performance and disease resistance of weaned pigs experimentally infected with a pathogenic *E. coli***

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**Abstract  
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# Outline

1. Post-weaning stress & diarrhea
2. Botanicals/Phytogenic feed additives & their effects
3. Objectives & Experimental design
4. Results & Conclusions

# Weaning stress

Diet, Environment, Transportation, Pathogenic exposure



# *E. coli* infection

Pathogenic, F4 or F18

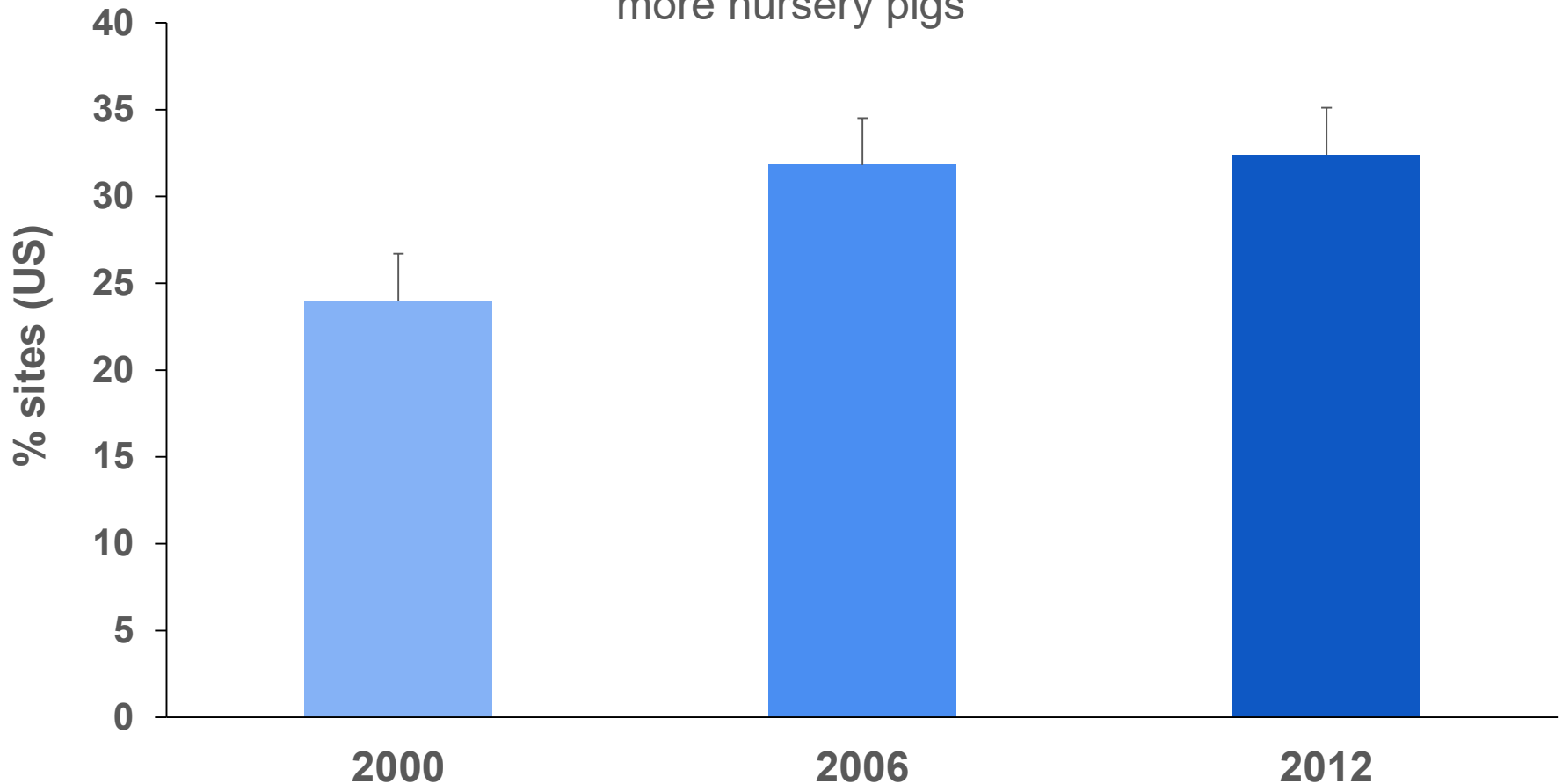


# Diarrhea

Decreased growth performance & health, increased mortality & economic losses

# Post-weaning *E. coli* diarrhea

Sites with known or suspected *E. coli* diarrhea cases in one or more nursery pigs



NAHMS, Section III: Management and Productivity Changes-D. Weaned Pig Morbidity

# Post-weaning diarrhea

- Mortality rates of nursery pigs ranged from 2.4 to 3.6%, of which diarrhea-caused death consist of 9.4 to 14.7% (NAHMS, 2012)
- In-feed antibiotics used for growth promoting purpose was banned in U.S. (FDA, 2016)



<https://www.feednavigator.com/Article/2020/12/17/FDA-Sales-of-antibiotics-for-food-producing-animals-rise-for-second-year-in-a-row>

# Botanicals/Phytogenic feed additives

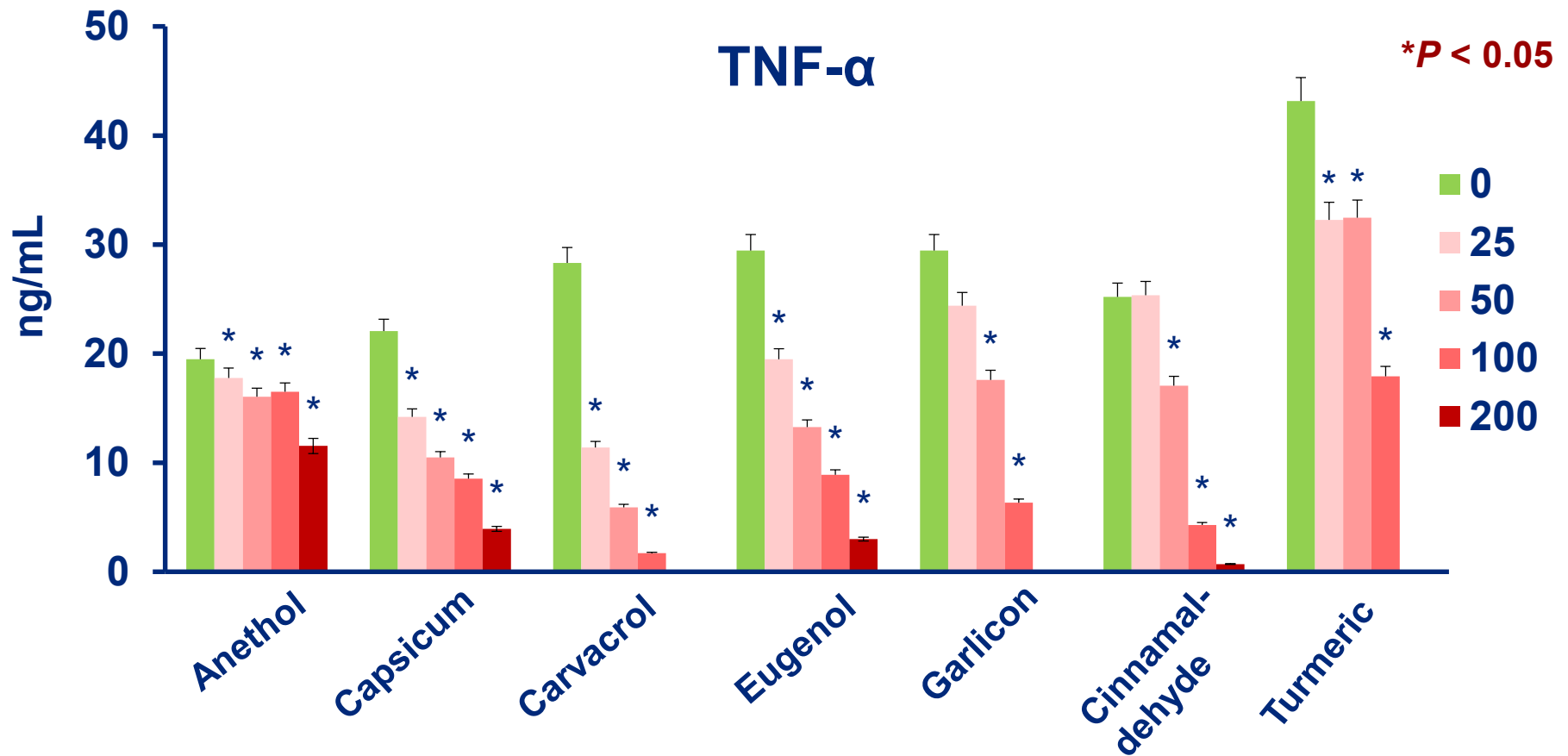
- Plant-derived substances and compounds
- Essential oils - aromatic oily liquids obtained from plant materials
- In vitro biological effects
  - *Antibacterial*
  - *Antioxidative*
  - *Antiviral*
  - *Antimycotic*
  - *Antiparasitic*



Burt, 2004; Windisch et al., 2008

# Anti-inflammatory effects

## In vitro



**LPS-stimulated porcine alveolar macrophages**

*Liu et al., 2012*

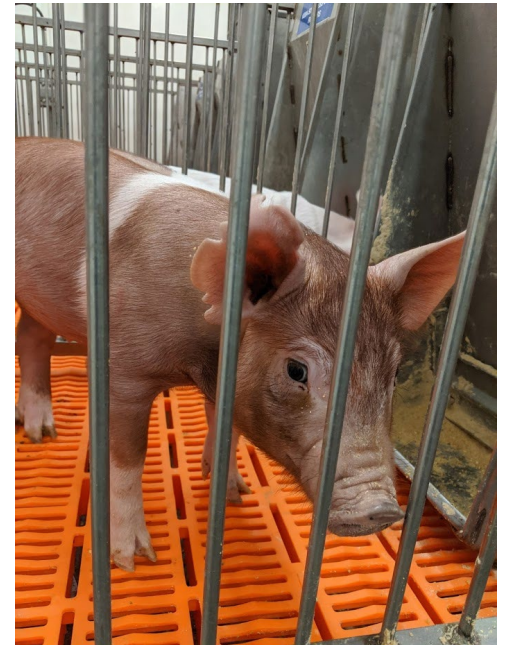
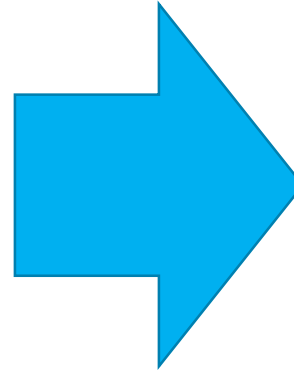
# Effects of botanicals on pig health and growth performance

Increase feed intake

Improve gut function

Nutrient absorption

Reinforce immune system

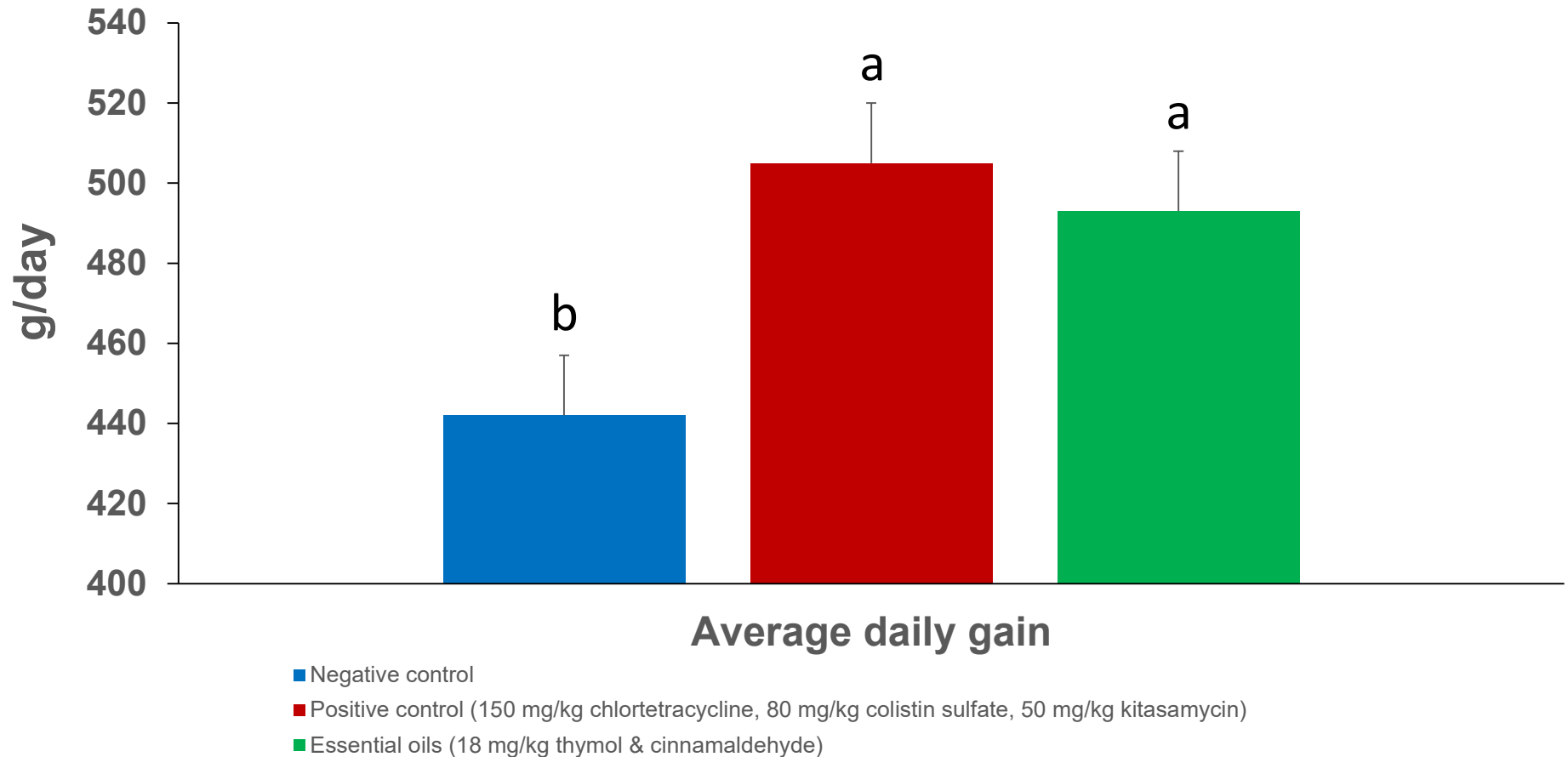


Source: [aasv.org](http://aasv.org); Zeng et al., 2015



# Thymol and cinnamaldehyde mixture enhanced weaned pig body weight

Overall (d 0 to 35 of study period)



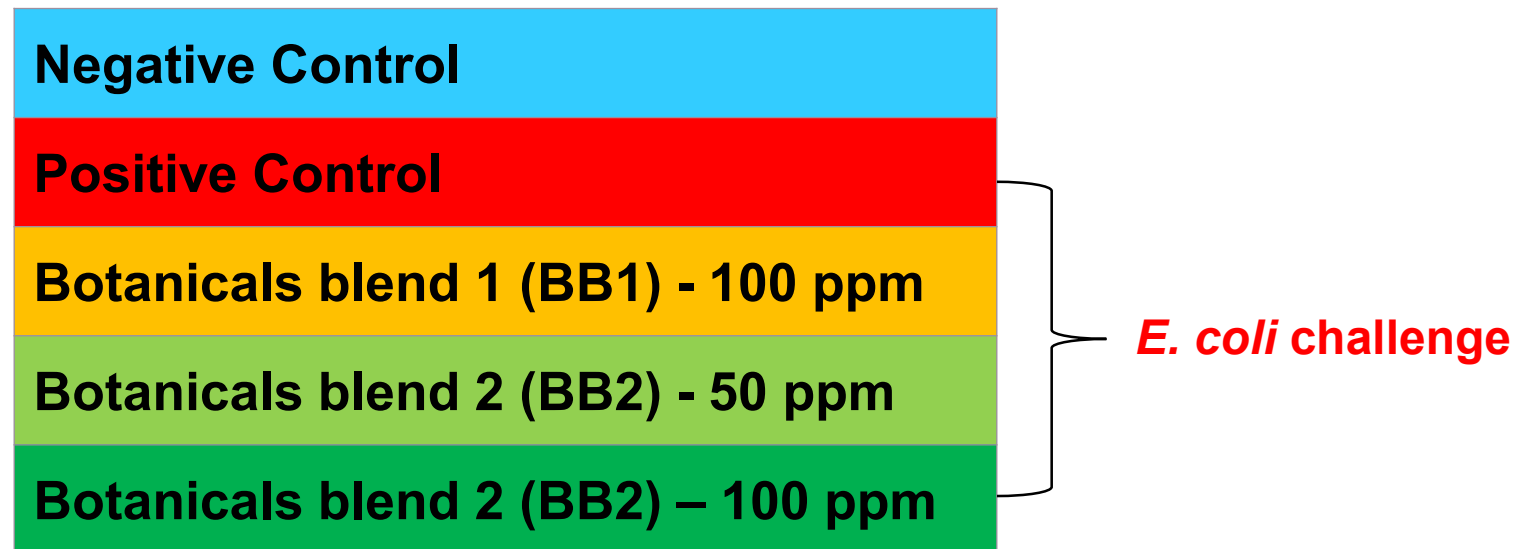
Li et al., 2012

# Objectives

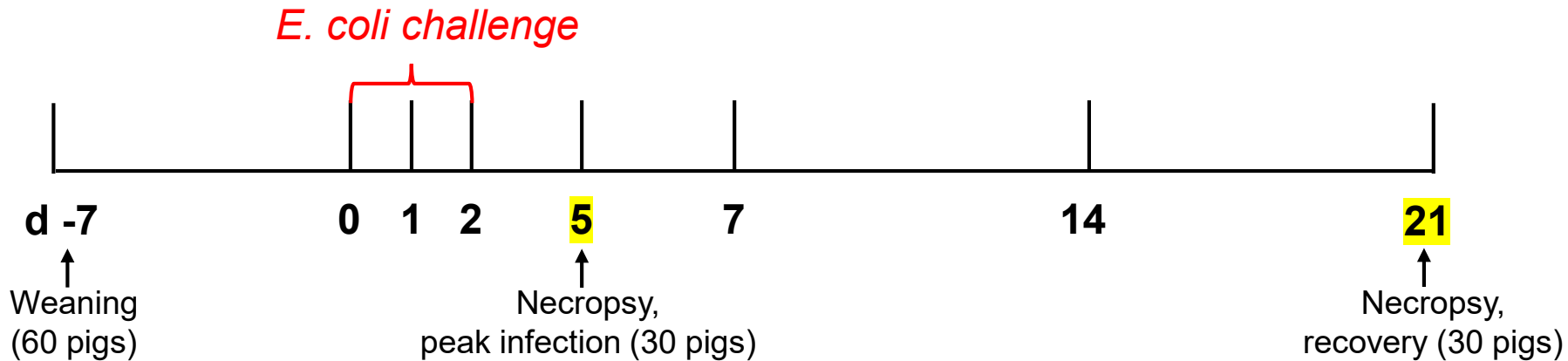
To investigate the effects of dietary supplementation of dietary botanical supplementation composed of **cloves, cinnamon, and garlic varieties** on **growth performance and frequency of diarrhea** of weaned piglets experimentally infected with a pathogenic F18 *E. coli*

# Experimental design

- **Randomized Complete Block Design:** blocks = body weight, sex, litter
- **60 weaning pigs:** crossbred, ~21 d old, initial BW = 7.17  $\pm$  0.97 kg
- **5 treatments:** 12 pigs/treatment



# Experimental timeline

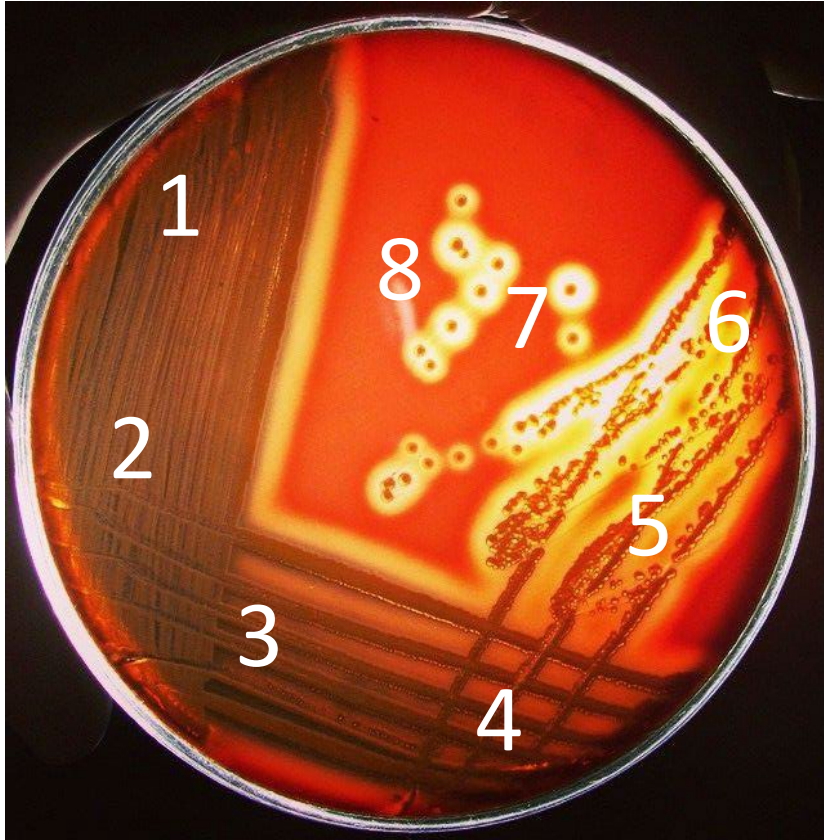


- All pigs were orally inoculated with 3 doses of pathogenic F18 *E. coli* ( $10^{10}$  cfu per dose, 3 consecutive days)

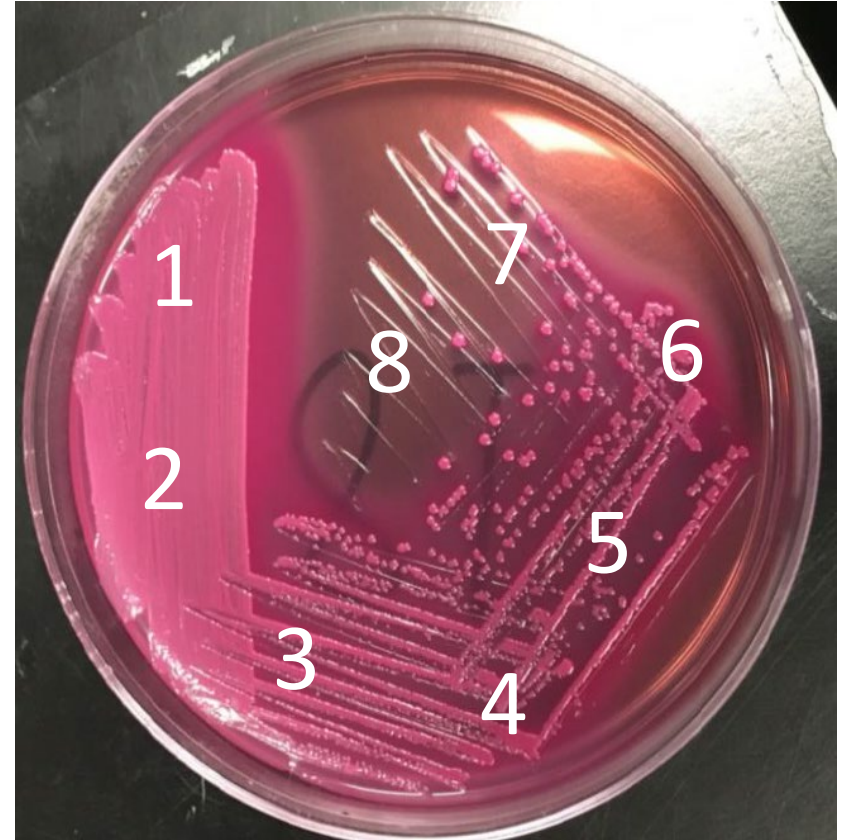
## Data collection:

- Growth performance – BW, average daily gain
- Diarrhea – Daily score, Frequency of diarrhea
- Feces –  $\beta$ -hemolytic coliforms

# Detection of $\beta$ -hemolytic coliforms



**Columbia blood agar**  
Detect  $\beta$ -hemolytic coliforms

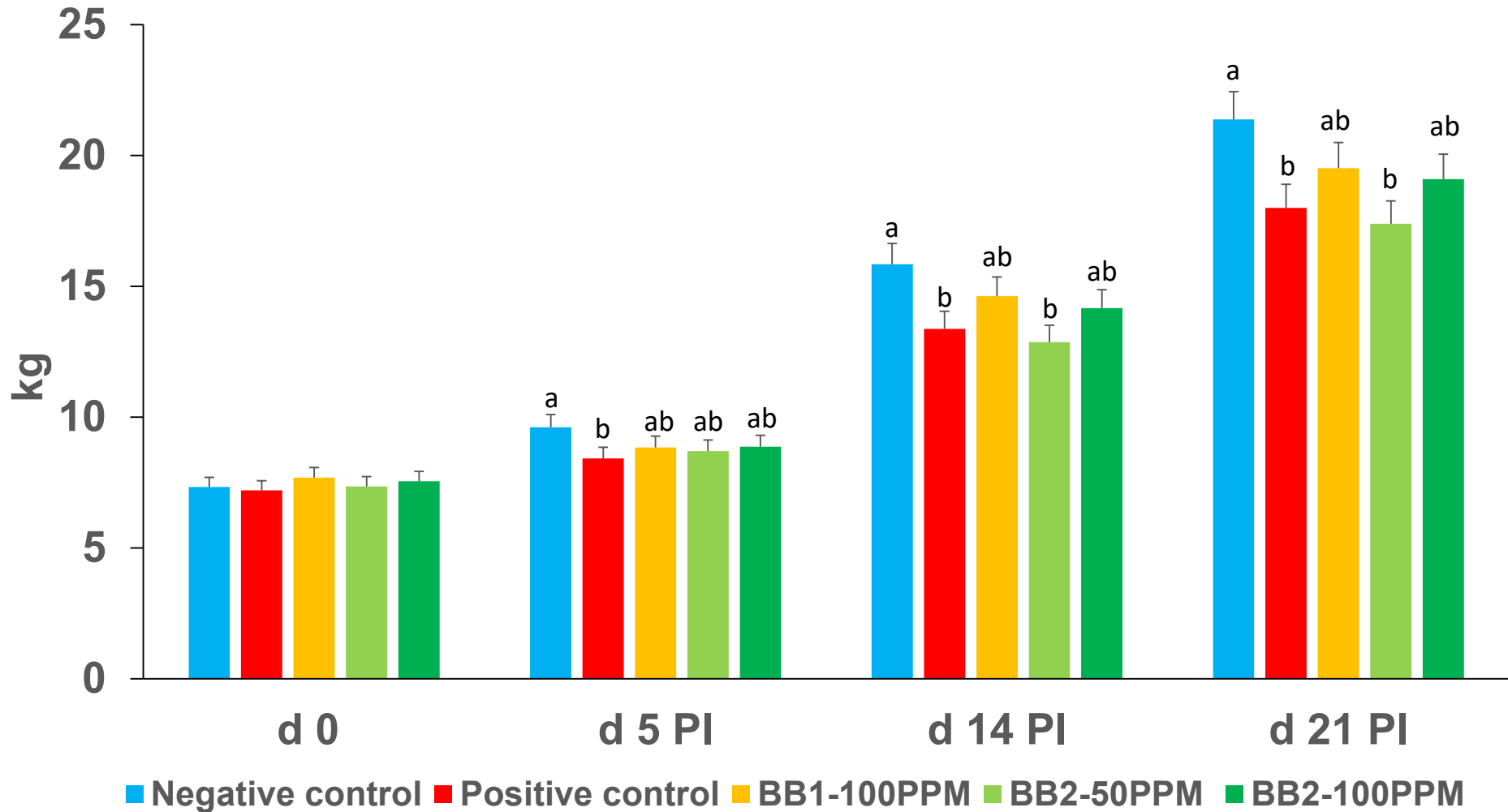


**MacConkey agar**  
Confirm lactose-fermenting bacteria

# Data calculation and statistical analysis

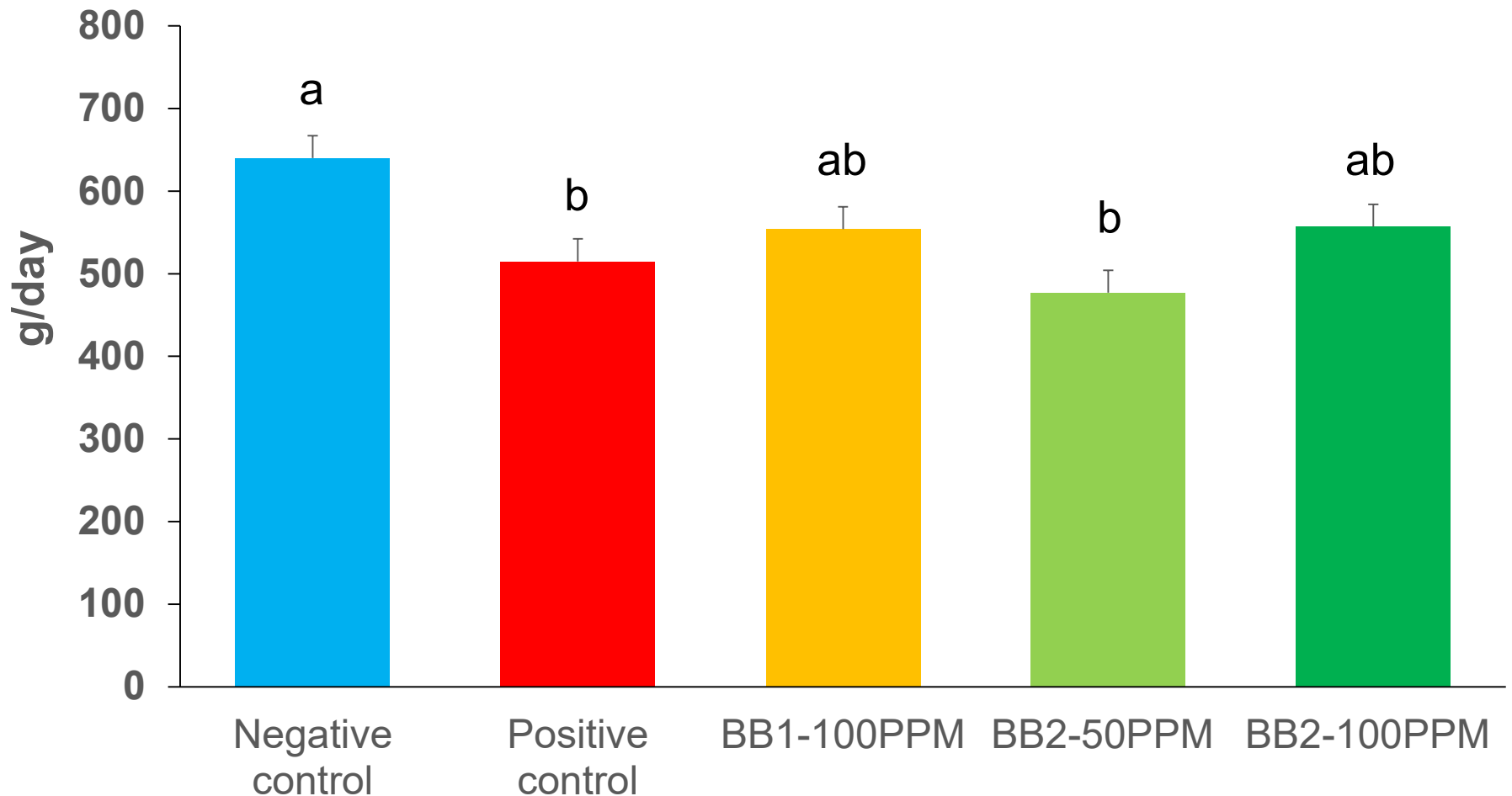
- **Frequency of diarrhea:** the percentage of pig days with diarrhea score  $\geq 3$
- All data were analyzed by ANOVA using the PROC MIXED of SAS
  - Frequency of diarrhea was analyzed by Chi-square
- **Statistical model:** diet as fixed effect and blocks as random effect
- Pig was experimental unit

# Body weight



# Average daily gain

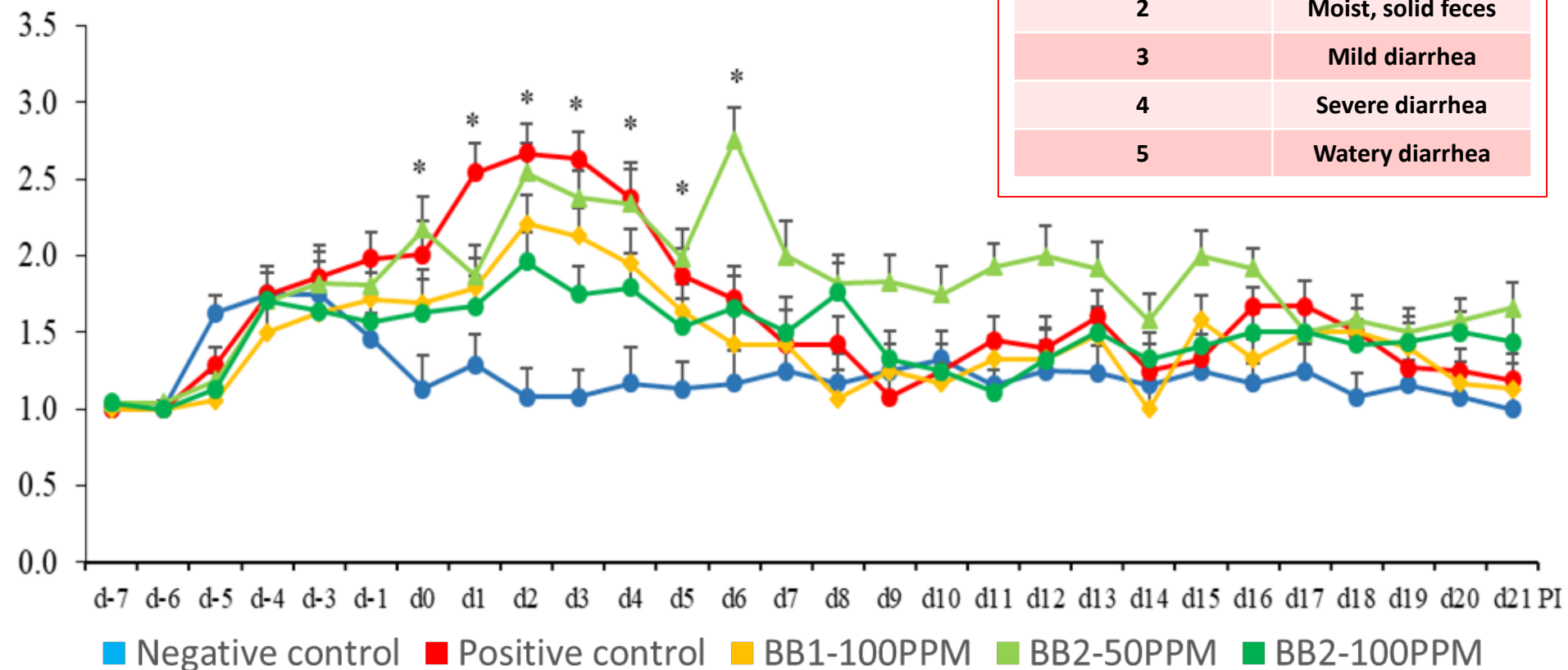
d 0 to 21 PI





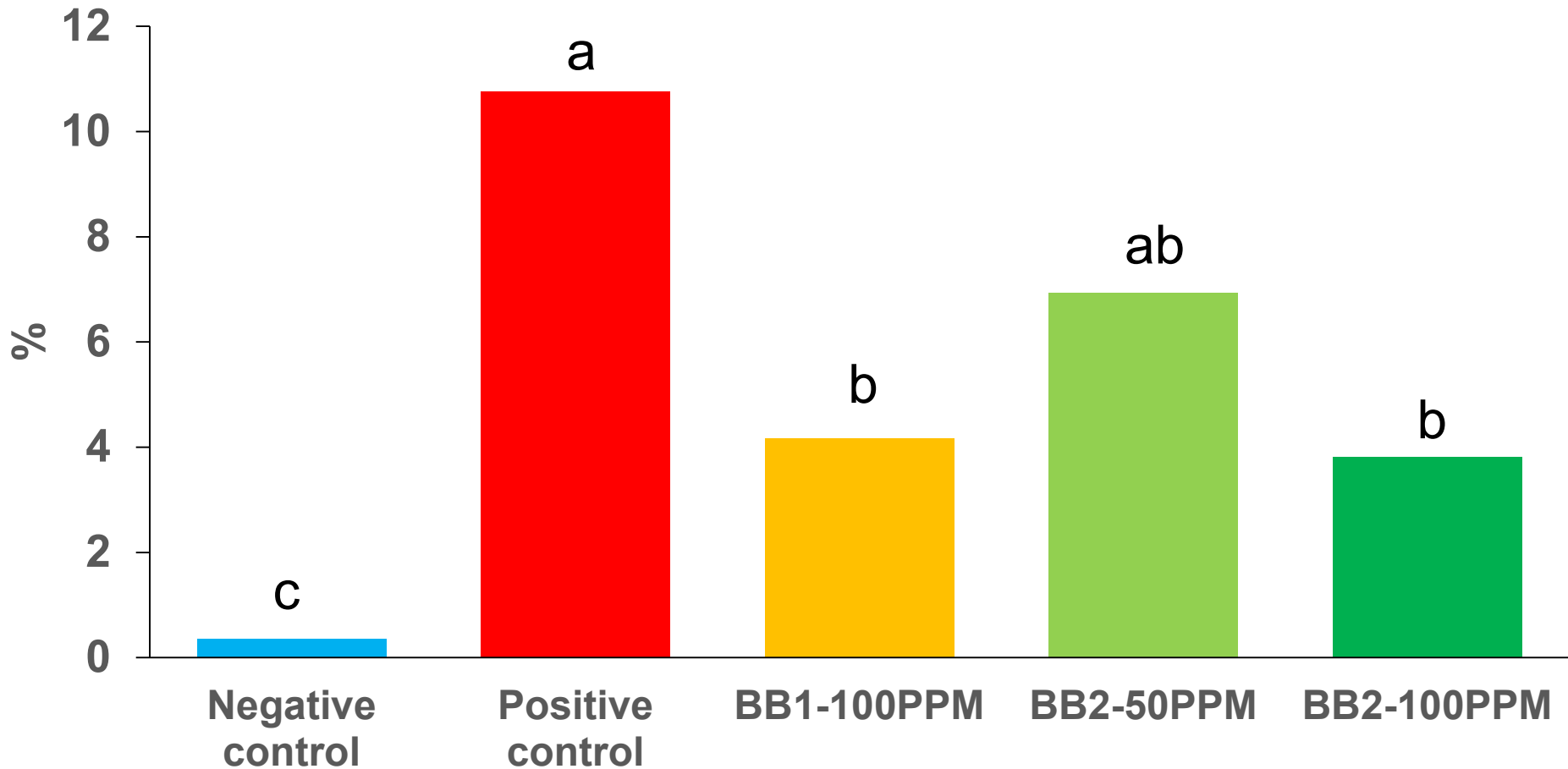
# Daily diarrhea score

Diarrhea score:	
1	Normal, solid feces
2	Moist, solid feces
3	Mild diarrhea
4	Severe diarrhea
5	Watery diarrhea

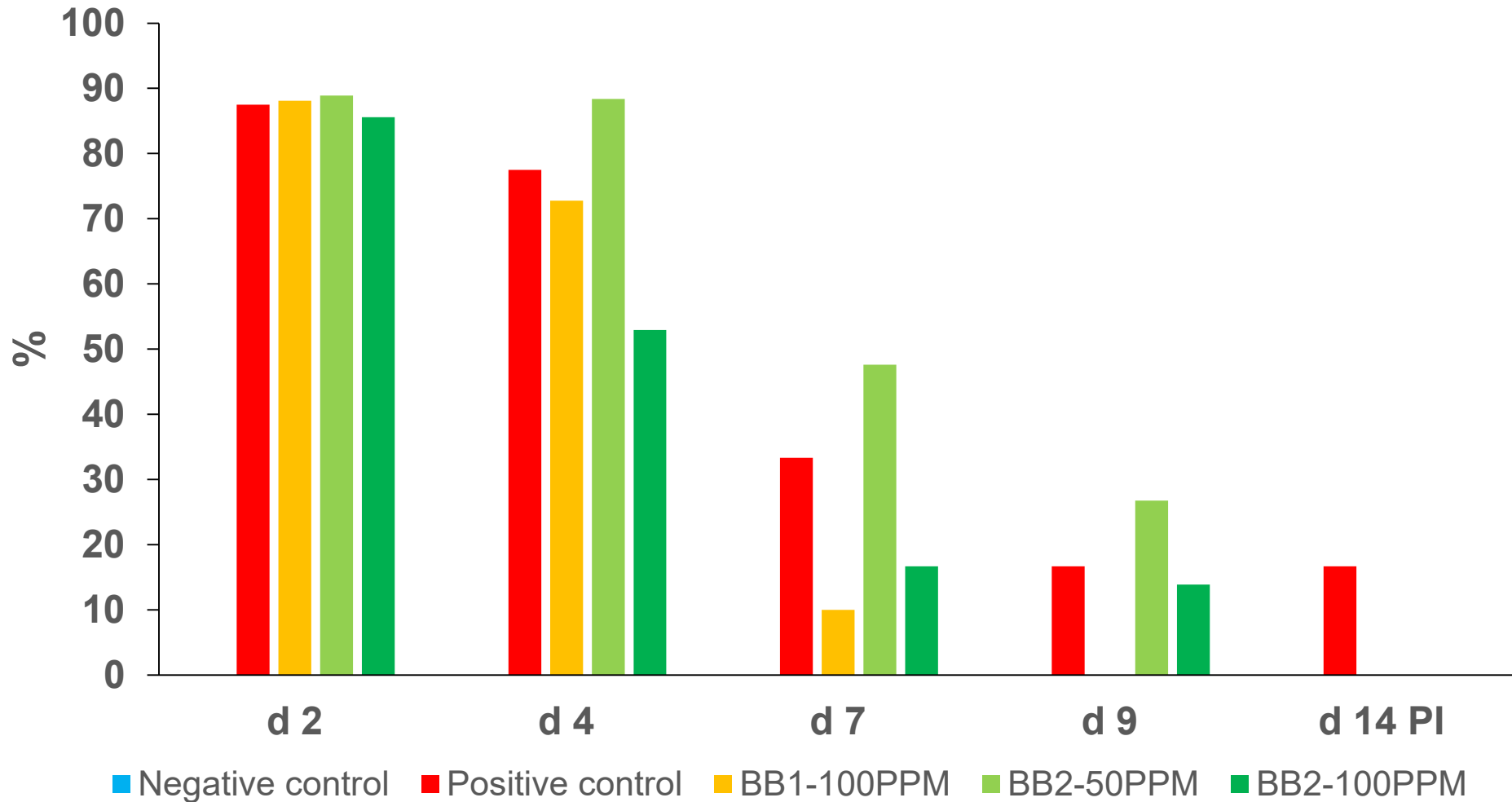


# Frequency of diarrhea

Overall (d 0 to 21 PI)



# $\beta$ -hemolytic coliforms



# Conclusions

Supplementation of high dose (100 ppm) botanical blend 1 or 2

- Enhanced growth performance
- Decreased diarrhea frequency

of weaned pigs experimentally infected with F18 *E. coli*.

## Future research:

- The impacts of botanical blends on gut microbiome
- The effects of botanical blends on systemic and intestinal inflammatory biomarkers

# Acknowledgements



# Thank you for your attention!

