



Supplementation of *Bacillus subtilis* enhanced growth rate and gut barrier function

of weanling pigs experimentally infected with F18 *Escherichia coli*

Kwangwook Kim¹, Yijie He¹, Xia Xiong¹, Cynthia Jinno¹, Amy Ehrlich¹, Xunde Li¹, Jens Jørgensen², Lena Raff², Yanhong Liu¹

¹University of California, Davis, CA, ²Chr. Hansen A/S, Hoersholm, Denmark



INTRODUCTION

- Enterotoxigenic *Escherichia coli* (*E. coli*) are the most dominant type of pathogenic *E. coli* that cause diarrhea in both pre-weanling and post-weanling pigs.
- Direct-fed microbials are live microorganisms which, when administered in adequate amounts, confer a health benefit on the host (FAO/WHO, 2001).
- *Bacillus subtilis* in diet could improve growth performance, intestinal morphology and immune responses of weaning pigs (Hu et al., 2014, Lee et al. 2014).

OBJECTIVE

- To investigate dietary supplementation of *Bacillus subtilis* on growth performance, diarrhea, gut permeability and immunity of weaned pigs experimentally infected with a pathogenic F-18 *E. coli*.

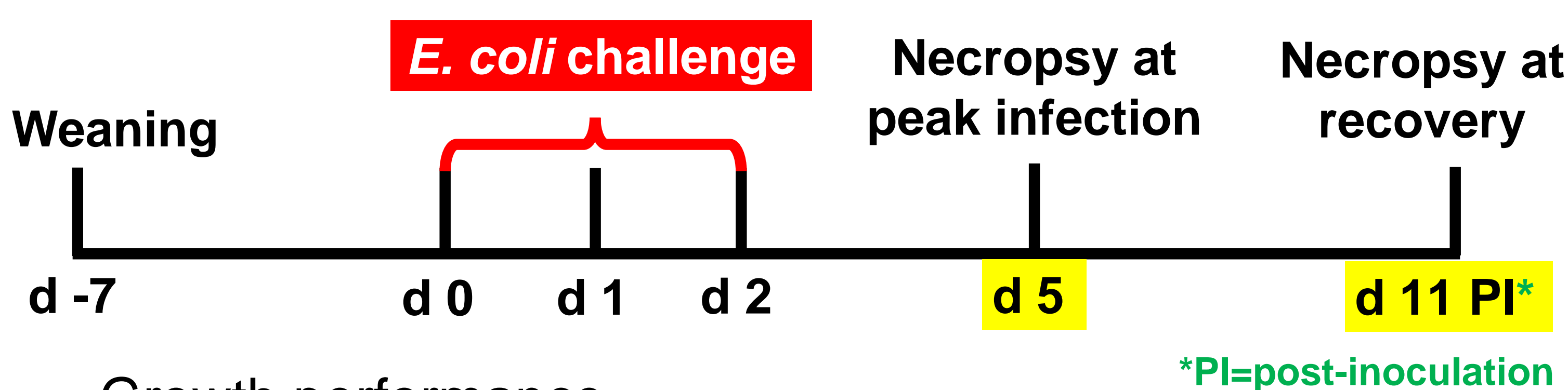
MATERIALS & METHODS

Experimental design & treatments

- Animals: 48 weanling pigs (6.73 ± 0.77 kg BW)
- Randomized complete block design
- Housing: Individually housed in disease containment rooms
- Treatment: 4 treatments (12 pigs/treatment)
 - ✓ Negative Control (NC)
 - ✓ Positive Control (PC)
 - ✓ Single dose *Bacillus subtilis*, 1.28 × 10⁹ CFU/kg diet
 - ✓ Double dose *Bacillus subtilis*, 2.56 × 10⁹ CFU/kg diet

Sampling and data collection

- Pathogenic F18 *E. coli* challenge (LT, STb, SLT-2); oral inoculation, 10¹⁰ cfu/dose with 3 doses

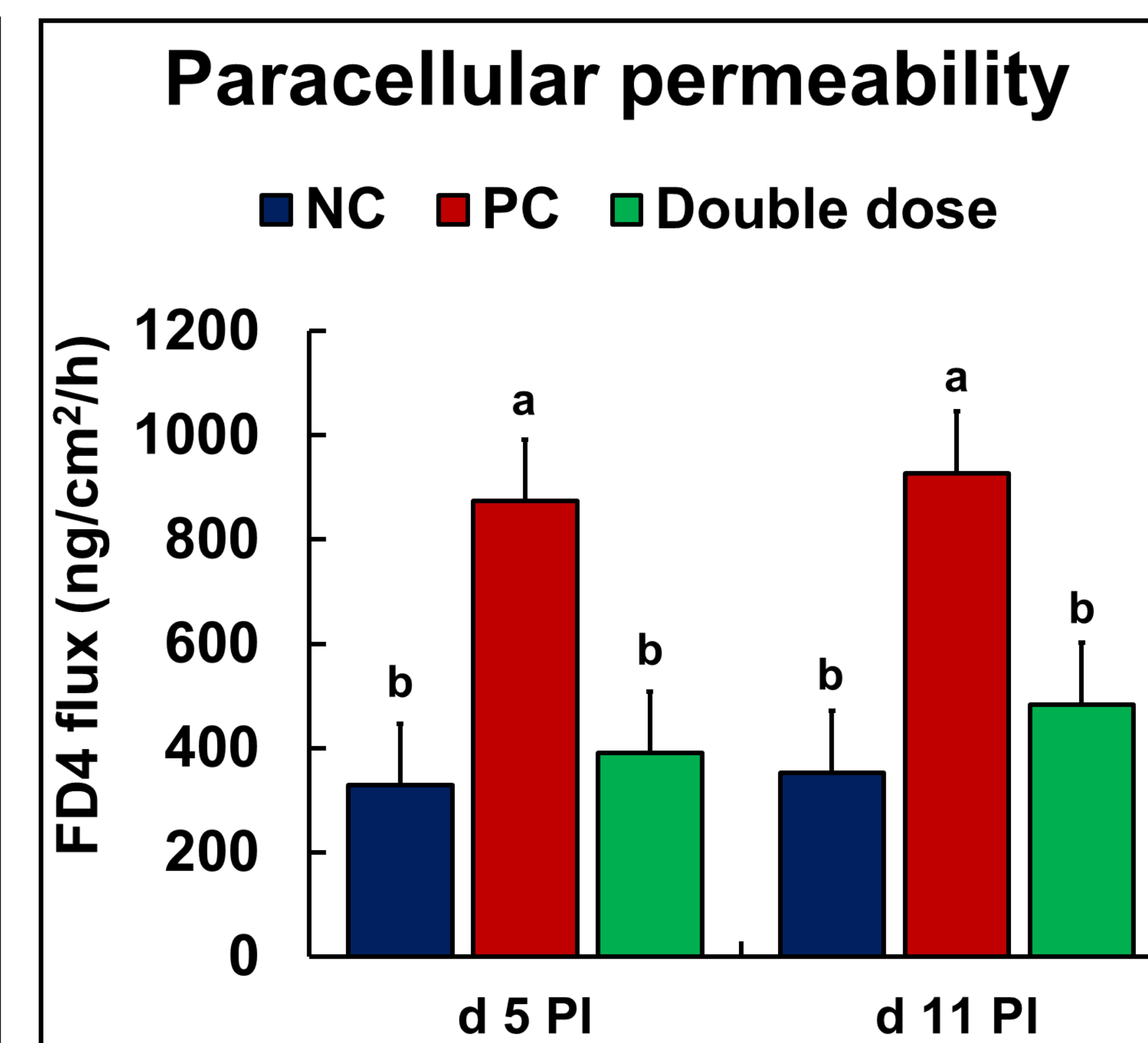
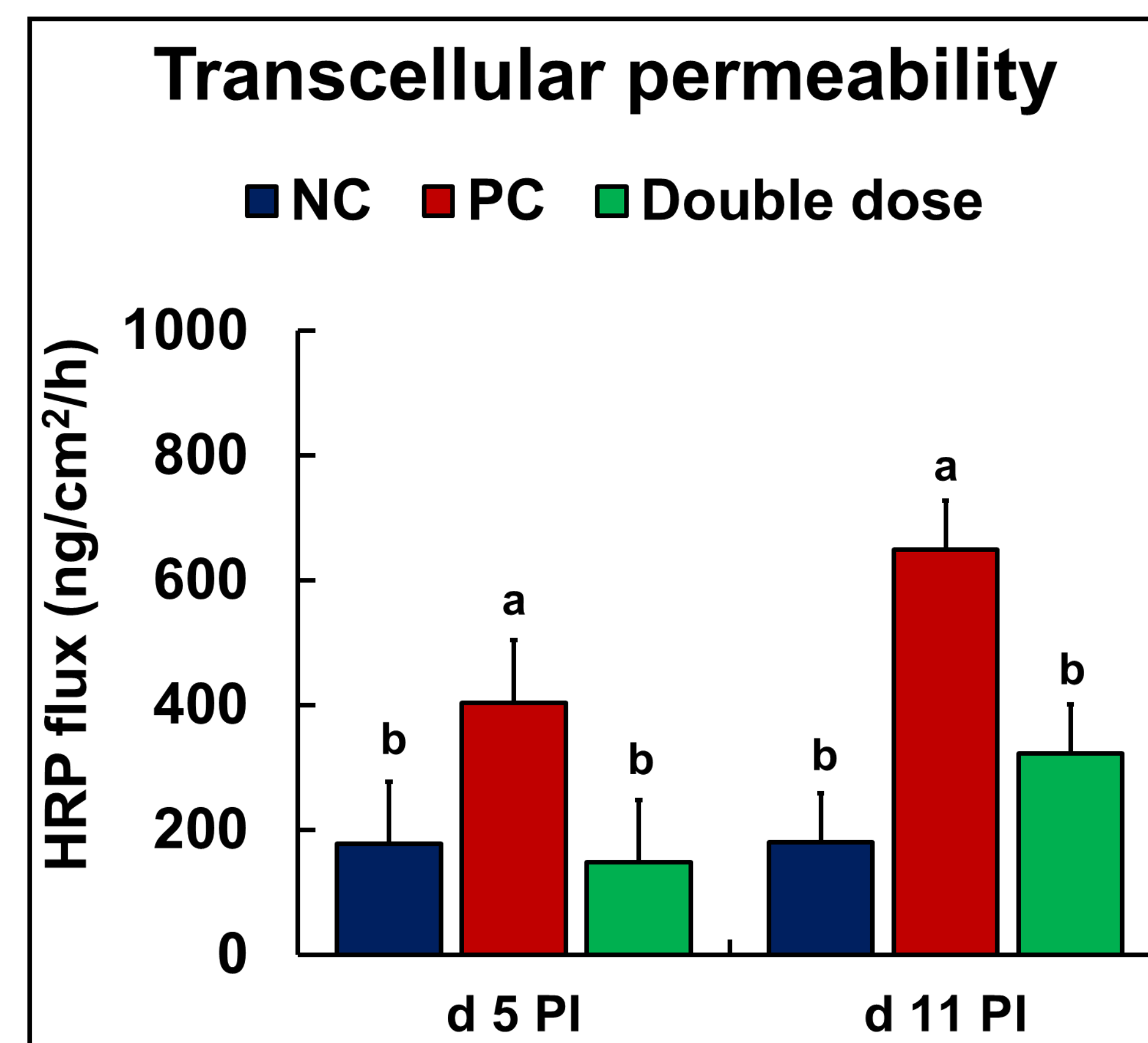
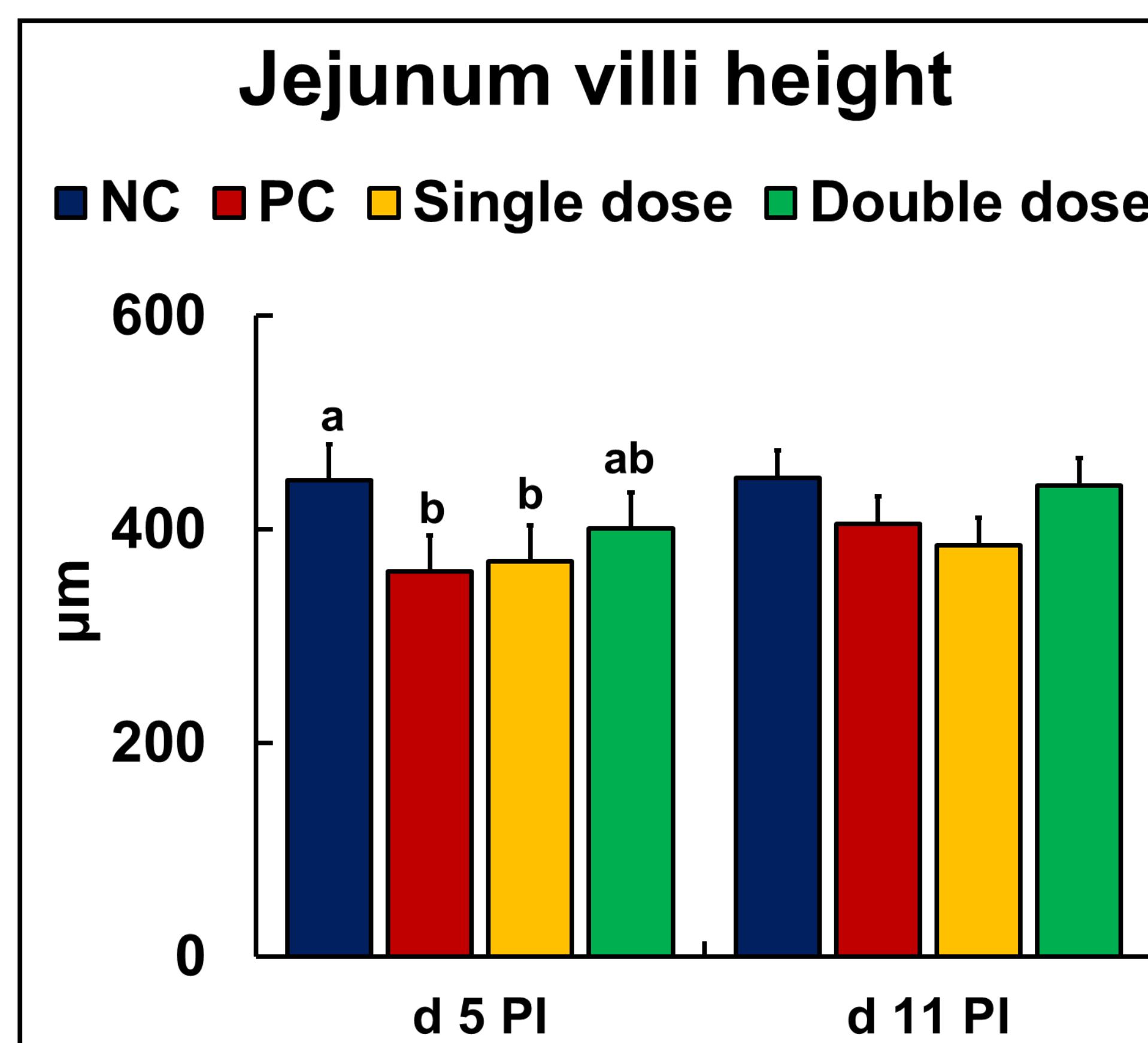
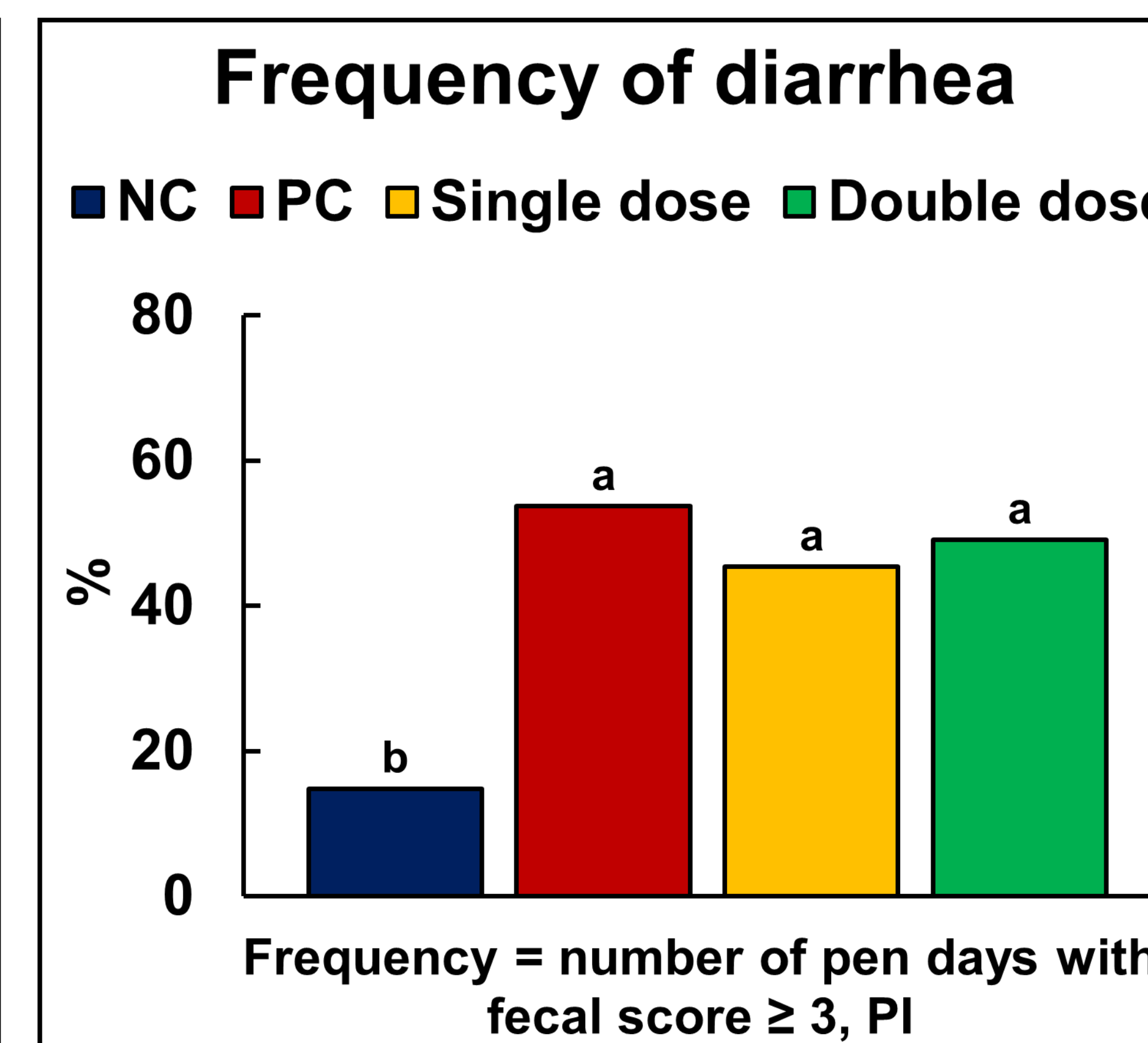
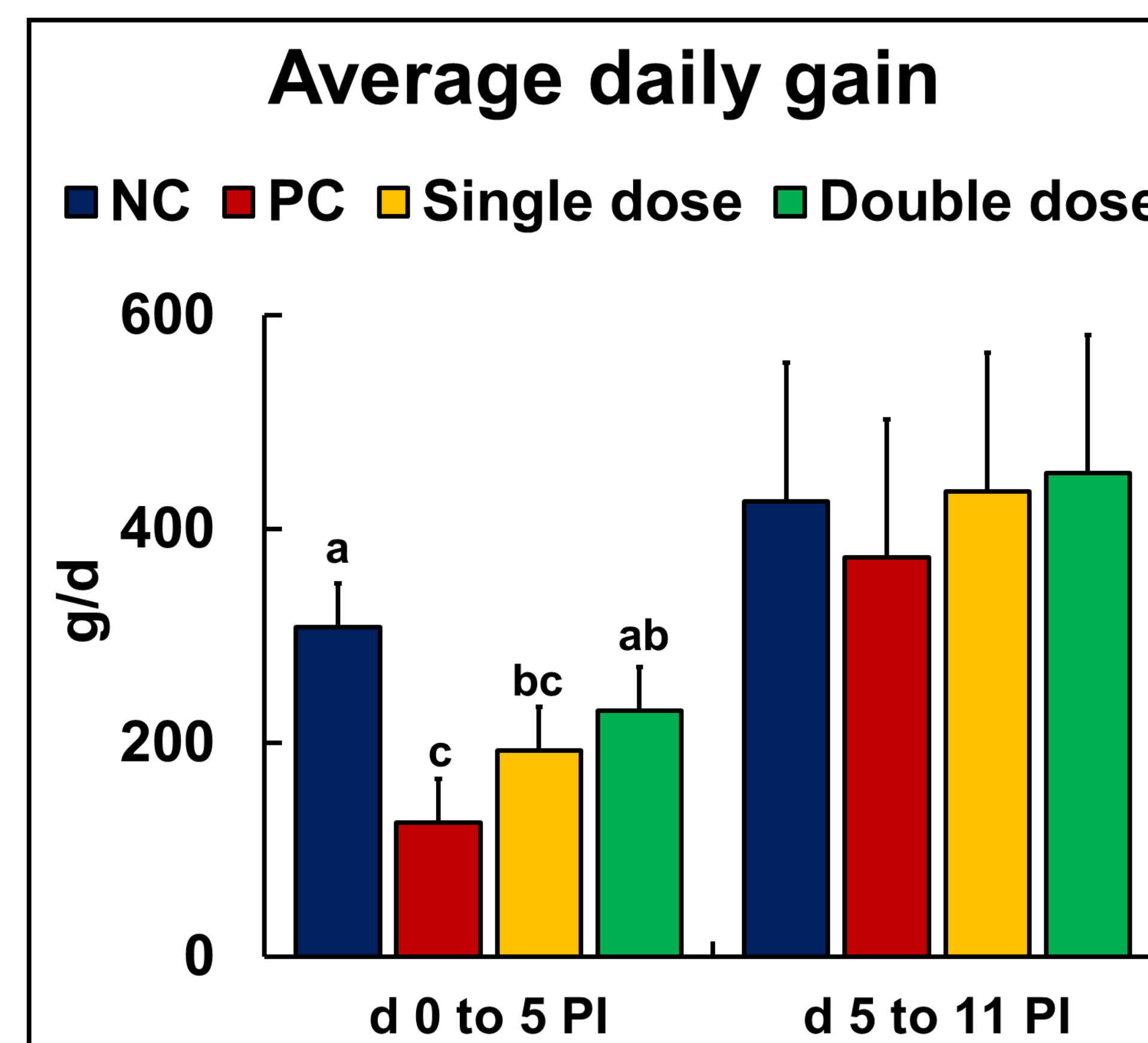
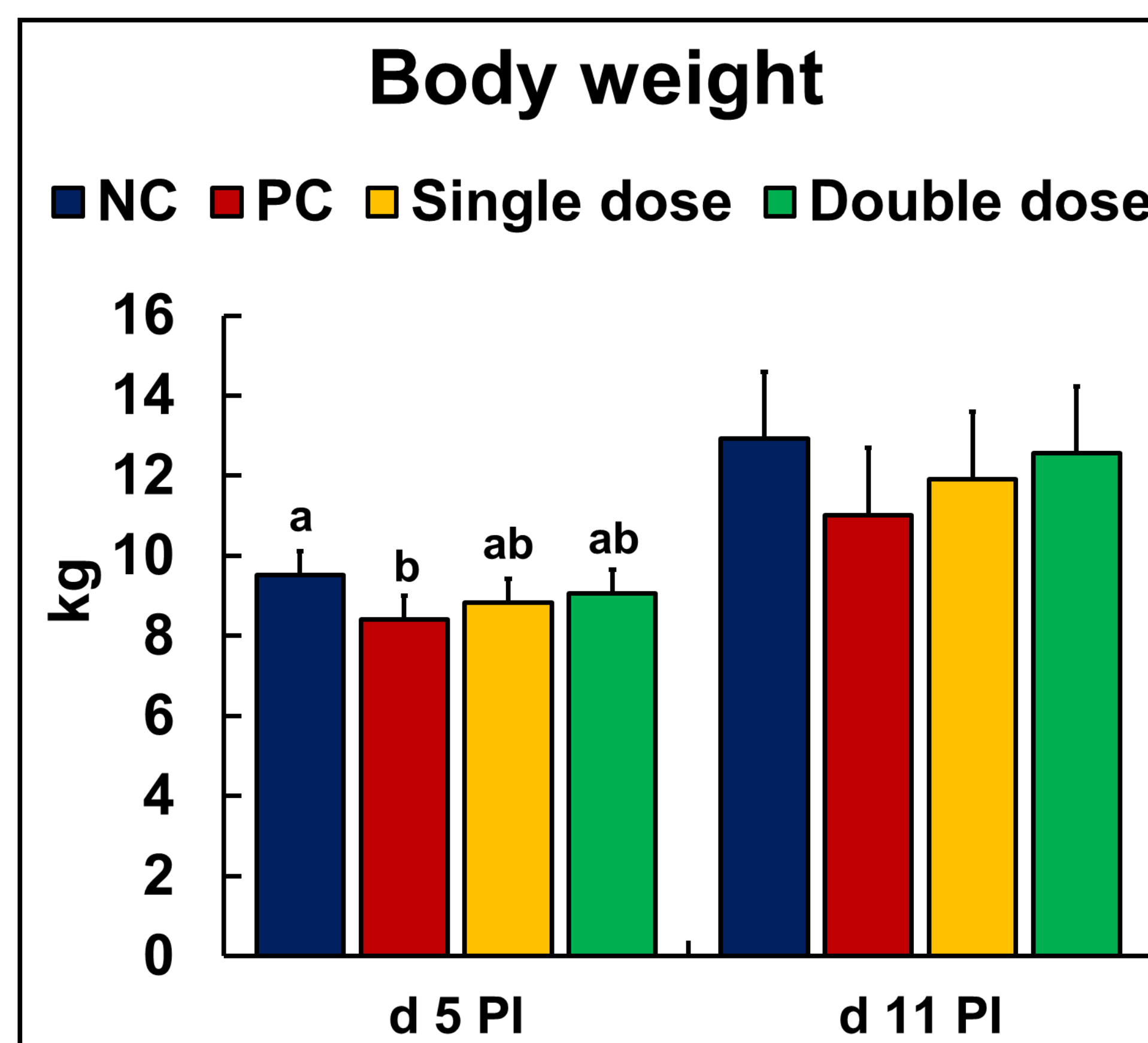


- Growth performance
- Daily diarrhea score
- Gut morphology of duodenum, jejunum and ileum
- Gut permeability of jejunum with Ussing Chamber
 - ✓ Transcellular (Horseradish peroxidase)
 - ✓ Paracellular (FITC-4000)
- mRNA expression of tight junction proteins in jejunal mucosa
- mRNA expression of immune genes in ileal mucosa

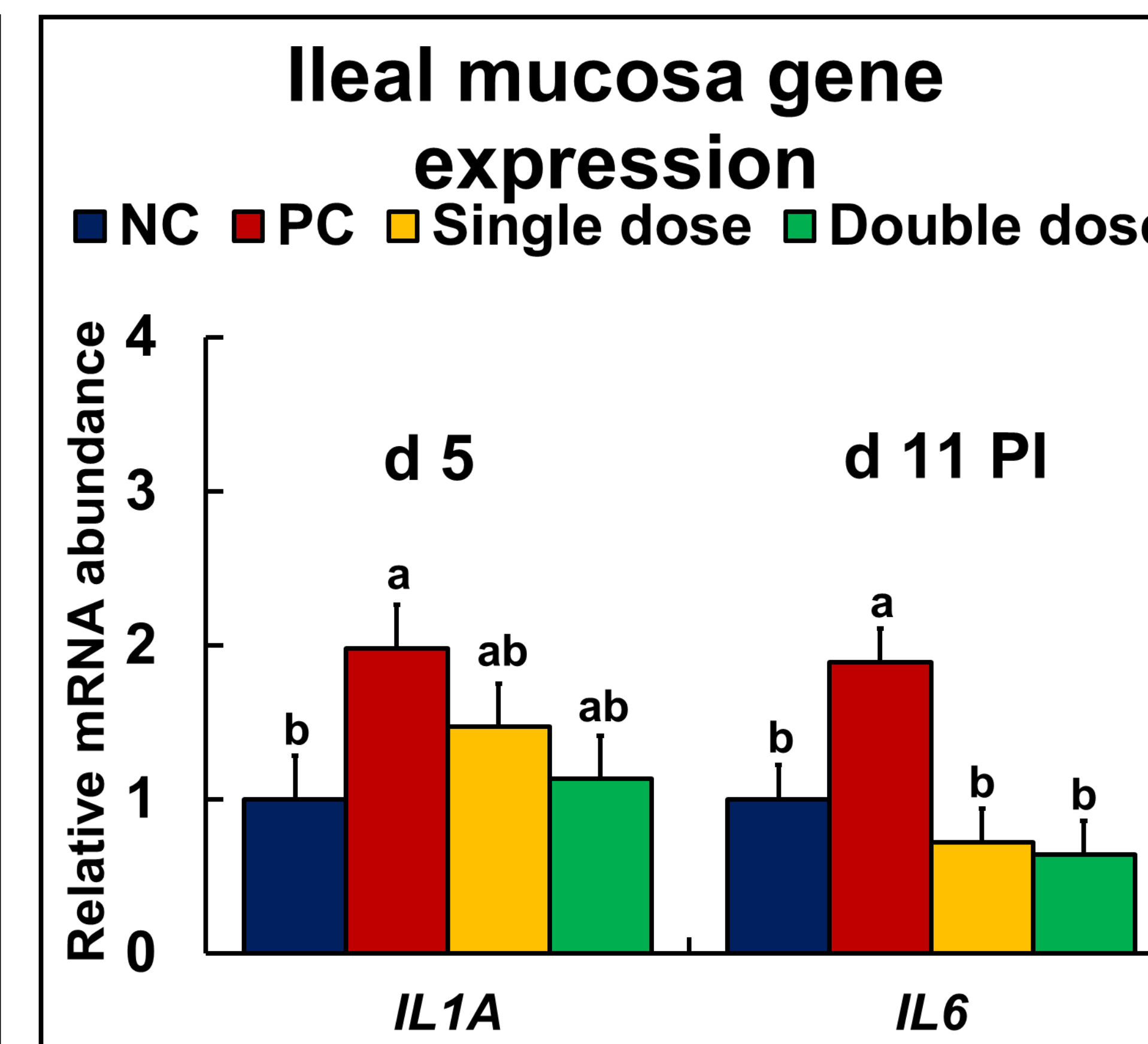
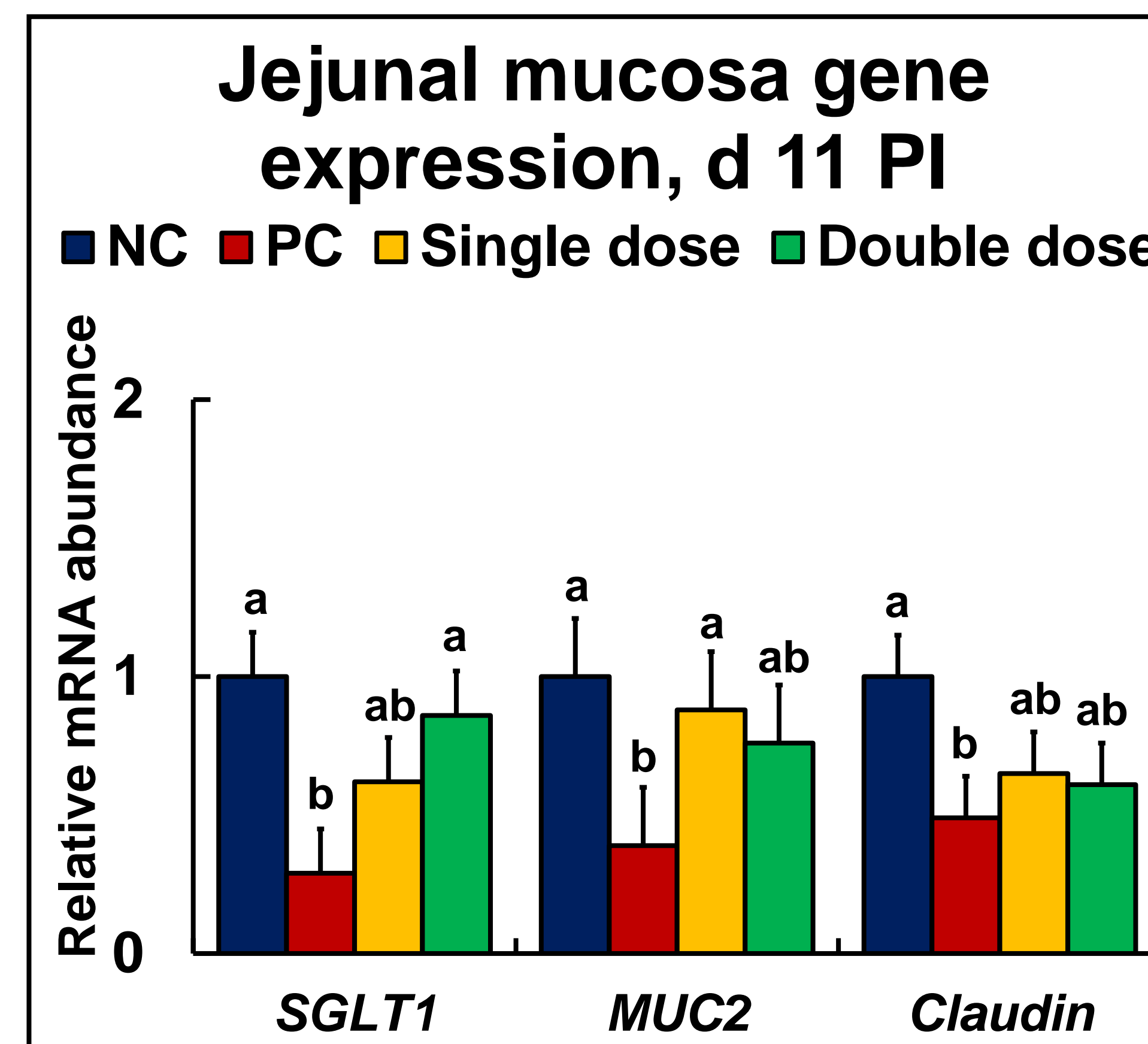
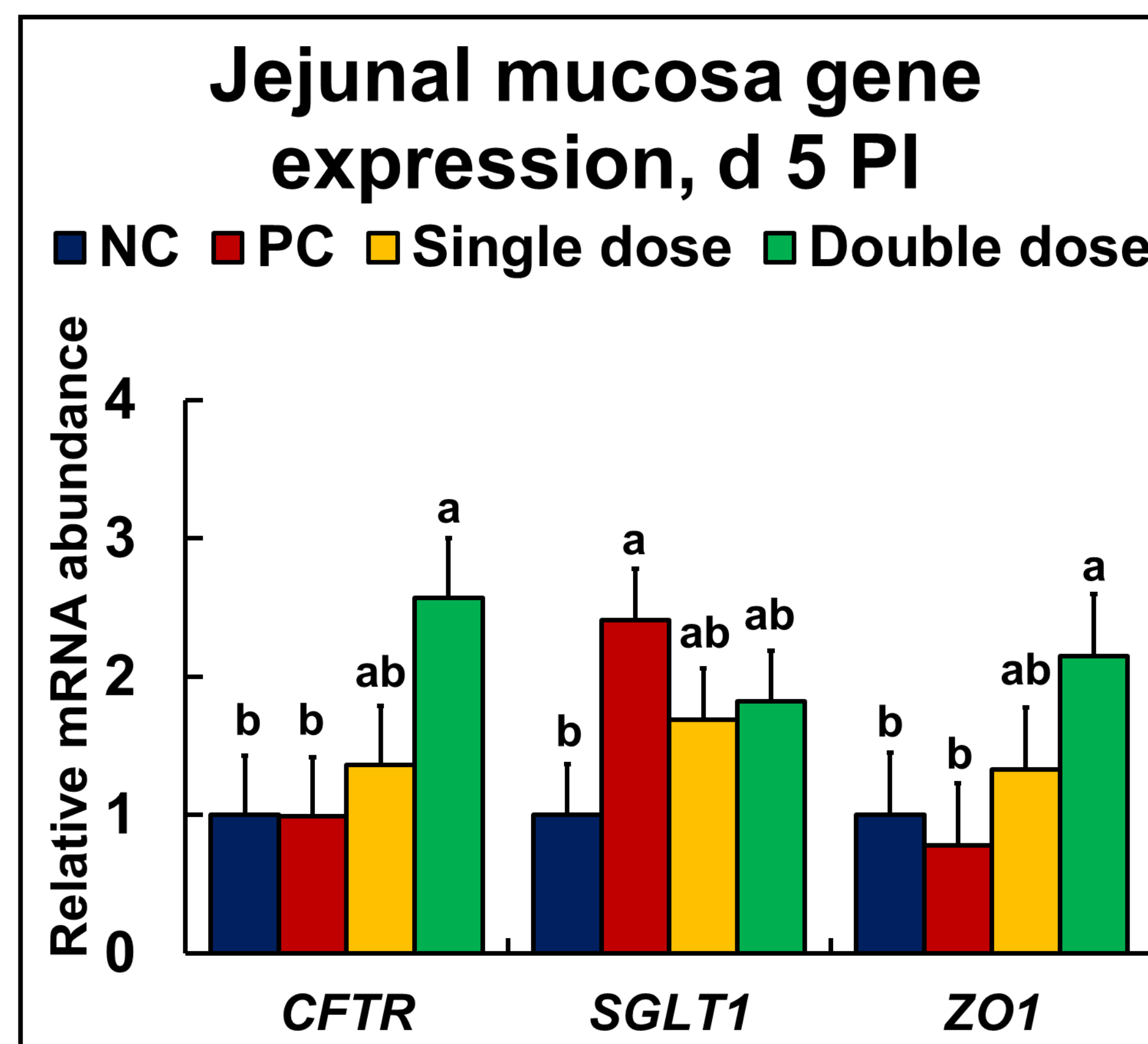
Statistical analysis

- All data were analyzed by ANOVA using the PROC MIXED of SAS. Significant difference at *P* < 0.05.

RESULTS



• No significant differences among treatments on intestinal villi height: crypt depth



CONCLUSIONS

- Supplementation of *Bacillus subtilis* improved growth rate and reduced leaky gut of weaned pigs infected with a pathogenic *E. coli*.
- Supplementation of *Bacillus subtilis* enhanced gut barrier functions and reduced gut inflammation of weaned pigs.