

Effects of dietary β -glucan on Growth Performance, Diarrhea, and Gut Permeability of Weaning Pigs Experimentally Infected with a Pathogenic *E. coli*

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ABSTRACT #69

Abstract

ProGlucan™ is 100% dried algae, *Euglena gracillus*, which contains approximately 54% β -1,3-glucan. The objective of this experiment was to investigate the influence of dietary supplementation of ProGlucan on growth performance, diarrhea score, and gut permeability of weaned pigs experimentally infected with a pathogenic F-18 *E. coli*. Weaned pigs (n = 36, 7.69 \pm 0.77 kg BW) were individually housed in disease containment rooms and randomly allotted to one of three dietary treatments with 12 replicate pigs in each treatment. The three diets were a nursery basal diet (control), and 2 additional diets containing either 100 or 200 mg/kg of ProGlucan in the basal diet. The experiment lasted 17 d [5 d before and 12 d after the first inoculation (d 0)]. The inoculum used in this experiment was F-18 *E. coli*, containing LT, STb, and SLT-2 toxins. The inoculation doses were 10¹⁰ cfu/3 mL oral dose daily for 3 days. The growth performance was measured on d 0 to 5, 5 to 12, and 0 to 12 post-inoculation (PI). Diarrhea score (DS; 1, normal, to 5, watery diarrhea) was recorded for each pig daily. Frequency of diarrhea was the percentage of pig days with DS of 4 or higher. Rectal temperature was measured for each pig daily after first inoculation. On d 5 and d 12, jejunum were collected from 4 pigs in the control group and high dose ProGlucan group for transcellular and paracellular permeability analysis. All data were analyzed by ANOVA using the PROC MIXED of SAS with pig as the experimental unit. The Chi-square test was used for the frequency of diarrhea analysis. No differences were observed in growth rate and feed intake of *E. coli*-challenged pigs throughout the experiment. Pigs fed 100 mg/kg ProGlucan had lower ($P < 0.05$) rectal temperature compared with pigs fed the control diet on d 5 and 7 PI. Inclusion of 200 mg/kg ProGlucan reduced ($P < 0.05$) frequency of diarrhea (9.26 vs. 17.90%) for the entire experimental period and decreased ($P < 0.05$) transcellular permeability on d 12 PI compared with the control diet. In conclusion, supplementation of ProGlucan may enhance disease resistance of weaned pigs, as indicated by reducing frequency of diarrhea and gut permeability.

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Introduction

- Enterotoxigenic *E. coli* are the most dominant type of pathogenic *E. coli* that cause diarrhea in both pre-weaning and post-weaning pigs
- Beta-glucans are polysaccharides, present in cereal grains (oats and barley), fungi (e.g. mushroom) and yeast cell wall
- Beta-glucans in diet had beneficial effects on growth performance of weaning pigs (Dritz et al., 1995; Li et al., 2006)
- Beta-glucans could modulate immune responses, therefore, increase disease resistance of weaning pigs (Hiss et al., 2003)

Objective

- To investigate the influence of dietary supplementation of ProGlucan on growth performance, frequency of diarrhea and gut permeability of weaned pigs experimentally infected with a pathogenic F-18 *E. coli*

Materials & Methods

- Experimental design: RCBD (Blocks: BW x Sex)
- 36 weaning pigs (7.69 \pm 0.77 kg, 21 d old)
- Treatments: 3 dietary treatments (12 pigs/treatment)
 - Nursery basal diet (CON)
 - CON + 100 mg/kg ProGlucan
 - CON + 200 mg/kg ProGlucan
- Pathogenic F18 *E. coli* challenge (LT, STb, SLT-2); oral inoculation, 10¹⁰ cfu/dose with 3 doses
- Data recording
 - Growth performance
 - Daily diarrhea score (1, normal to 5, watery diarrhea)
 - Frequency of diarrhea
 - Rectal temperature
- Data analysis: AVONA using the PROC MIXED of SAS

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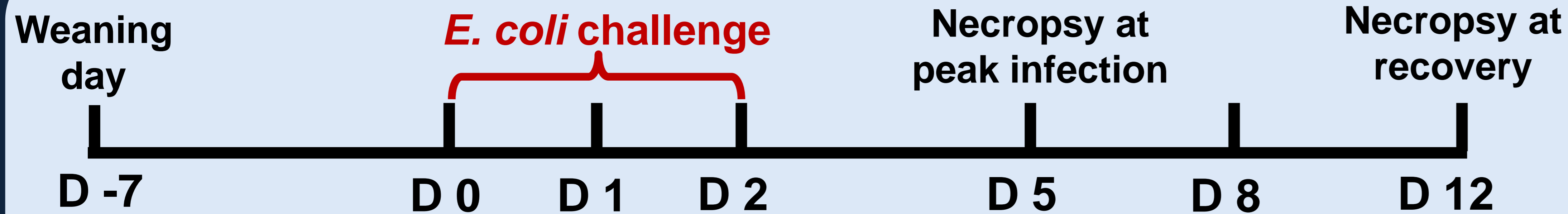
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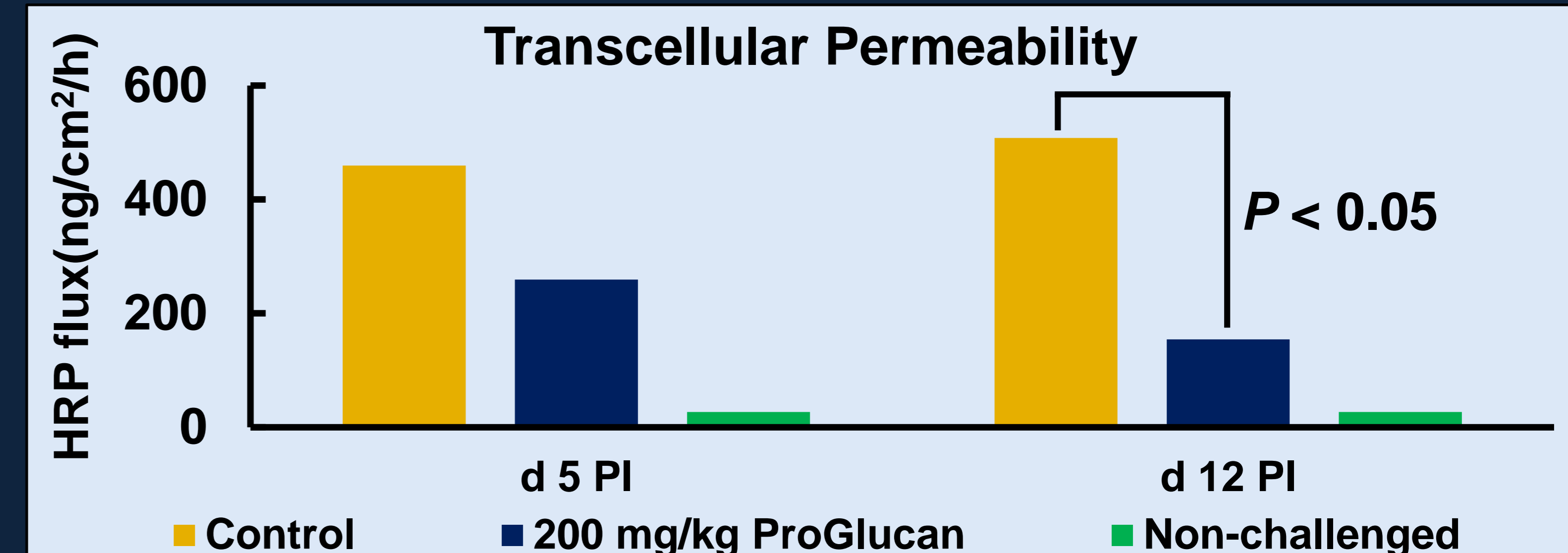
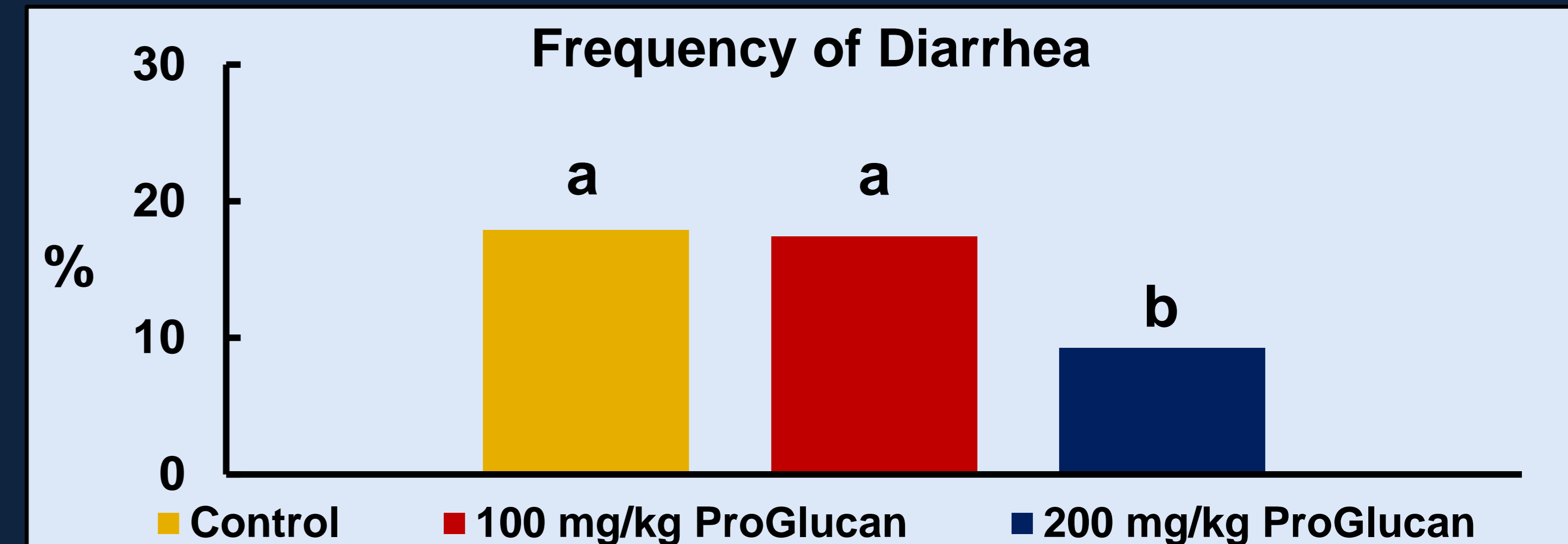


Materials & Methods



- Gut permeability of jejunum with Ussing Chamber
 - **Transcellular** (Horseradish peroxidase)
 - **Paracellular** (FITC-4000)
- Whole blood and serum samples
 - d 0 before inoculation and d 2, 5, 8, and 12 post-inoculation (PI)
 - Complete Blood Count: **Total and differential blood cell counts**
 - Flow cytometry: **CD4+ & CD8+ T cells, and B cells**
 - Enzyme-Linked Immunosorbent Assay (ELISA): **Serum IL-6, IL-10, cortisol, and haptoglobin**

Results



➤ No difference was observed in paracellular permeability (Control vs. 200 mg/kg ProGlucan)

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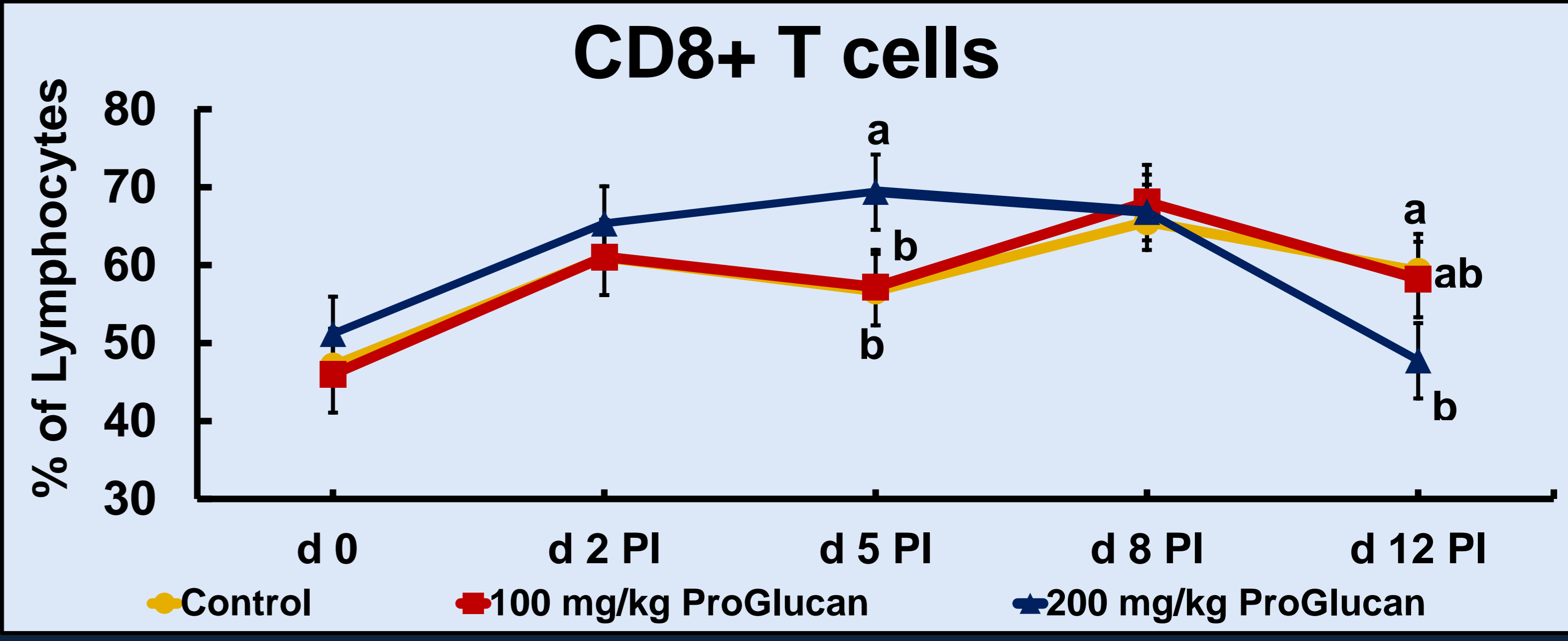
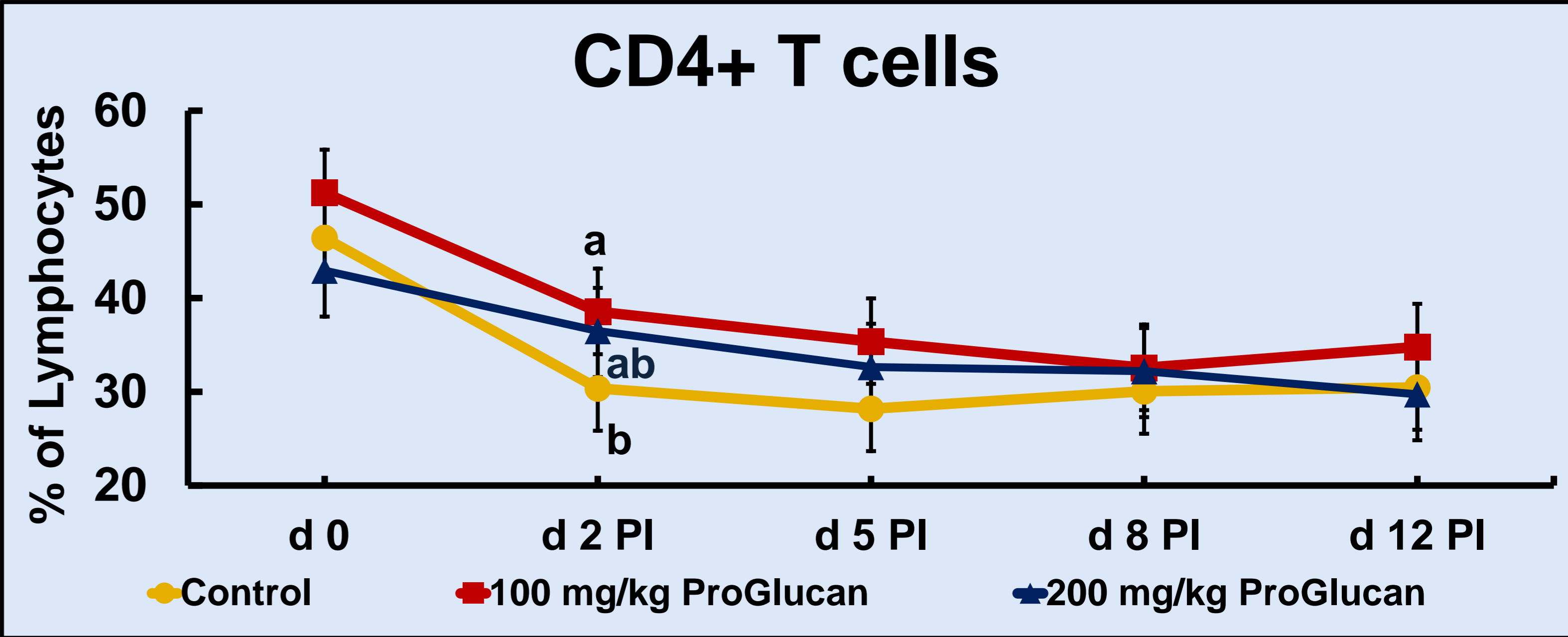
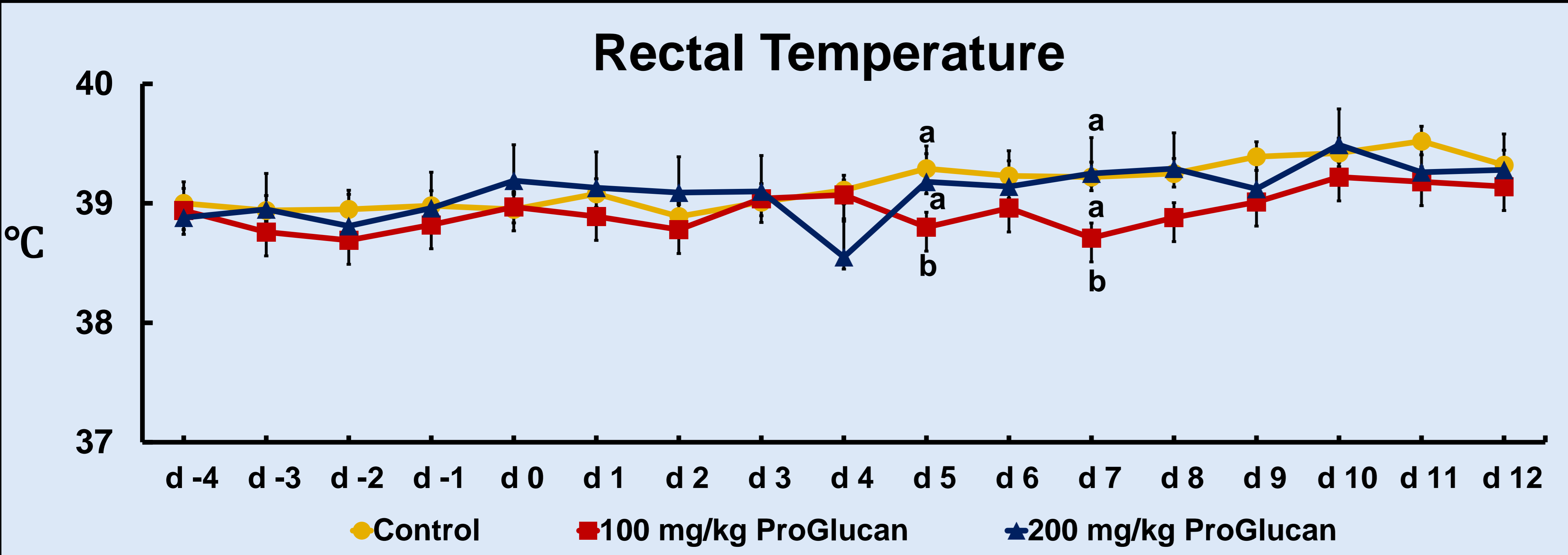
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Results



- No differences were observed in body weights, average daily gain, average daily feed intake, and feed efficiency among dietary treatments throughout the experiment
- No differences were observed in serum IL-6 and IL-10 among dietary treatments before and after *E. coli* challenge

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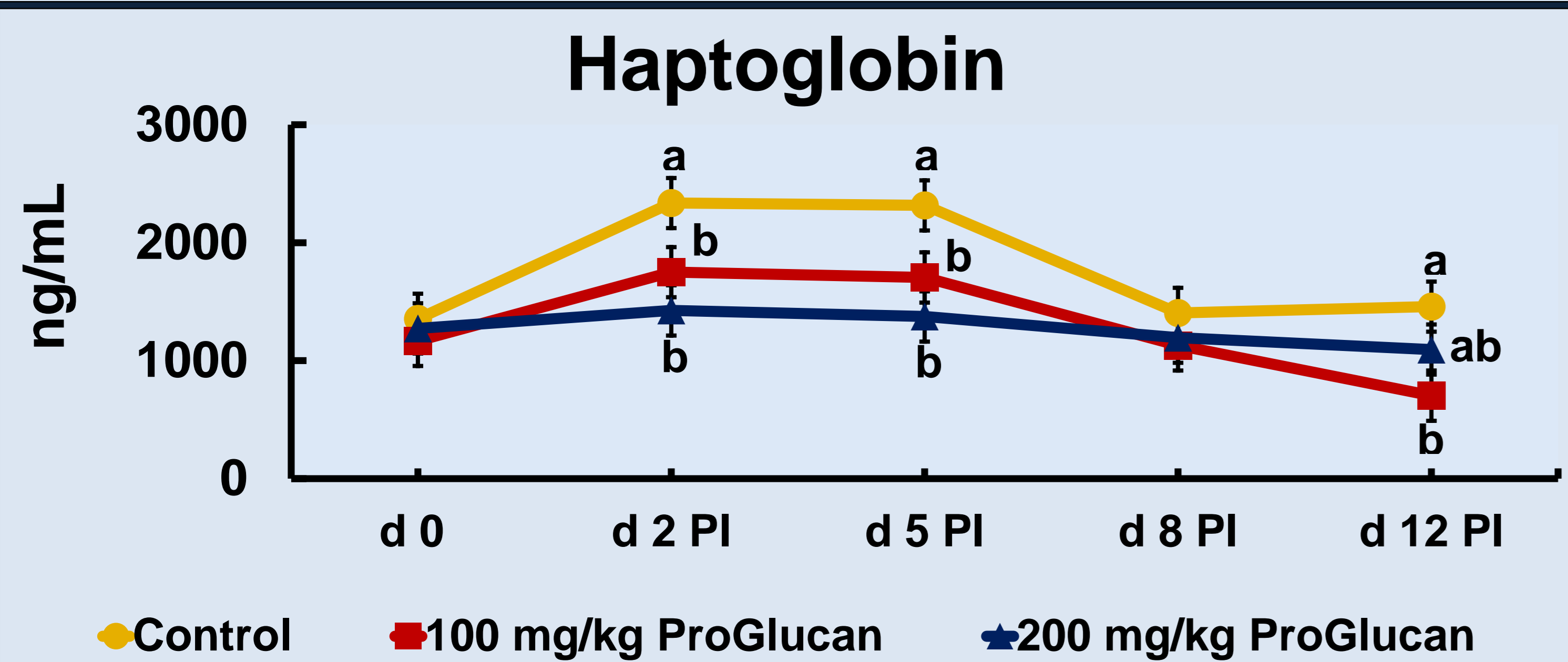
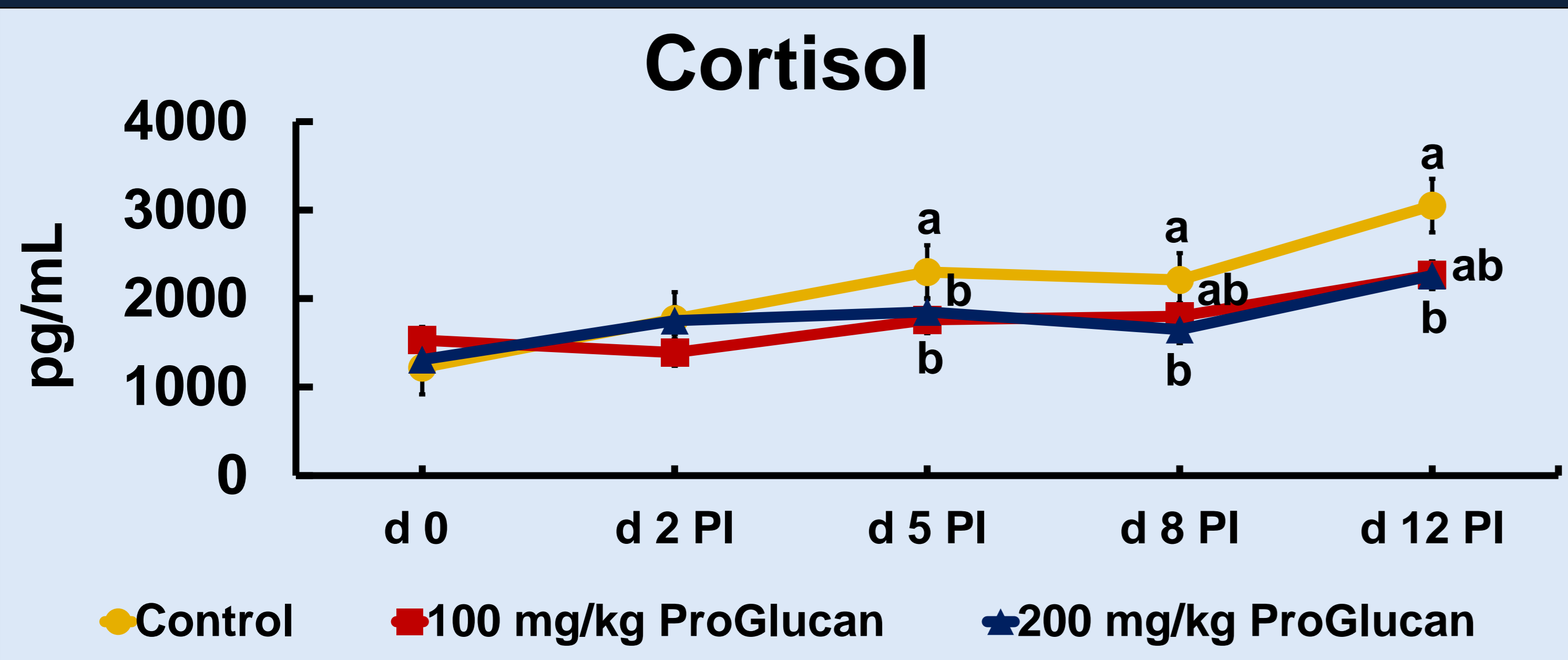
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Results



Conclusions

- Supplementation of ProGlucan may enhance **disease resistance** of weaned pigs, as indicated by reduced frequency of diarrhea
- Feeding ProGlucan may reduce **gut damage** caused by *E. coli* infection, as indicated by reduced gut permeability
- Supplementation of ProGlucan regulates systemic immunity of weaned pigs experimentally infected with a pathogenic *E. coli*
- Supplementation of ProGlucan reduces **systemic inflammation**, which may accelerate the recovery of weaned pigs from *E. coli* infection
- More research will be needed to decipher the potential benefits of β -glucan on gut health

References

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