



75th EAAP Annual Meeting
Florence – Italy



Parabacteroides distasonis Alleviates Intestinal Barrier Injury Induced by ETEC

EAAP 2024 Florence Italy

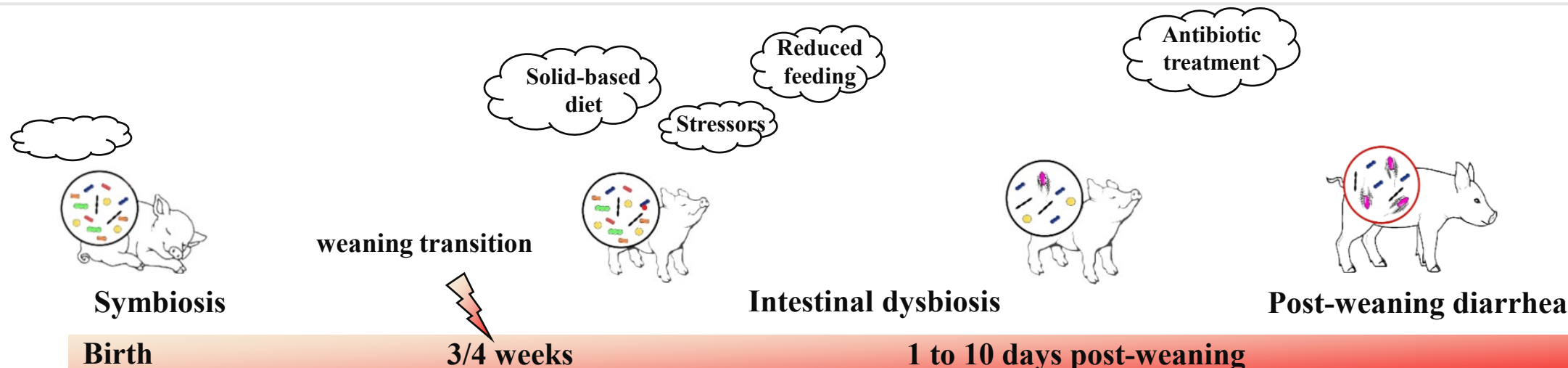
Jing Wang, Bie Tan

Sep 3th 2024

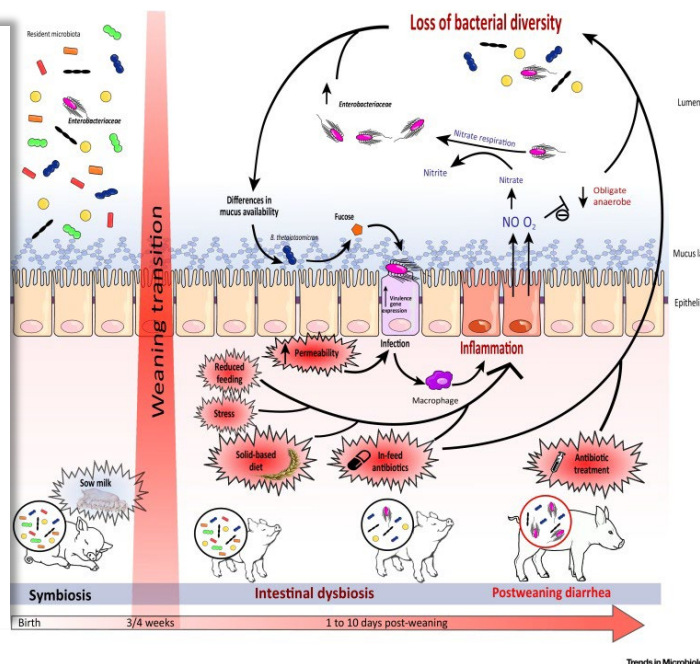
朴誠奮勉 求實創新



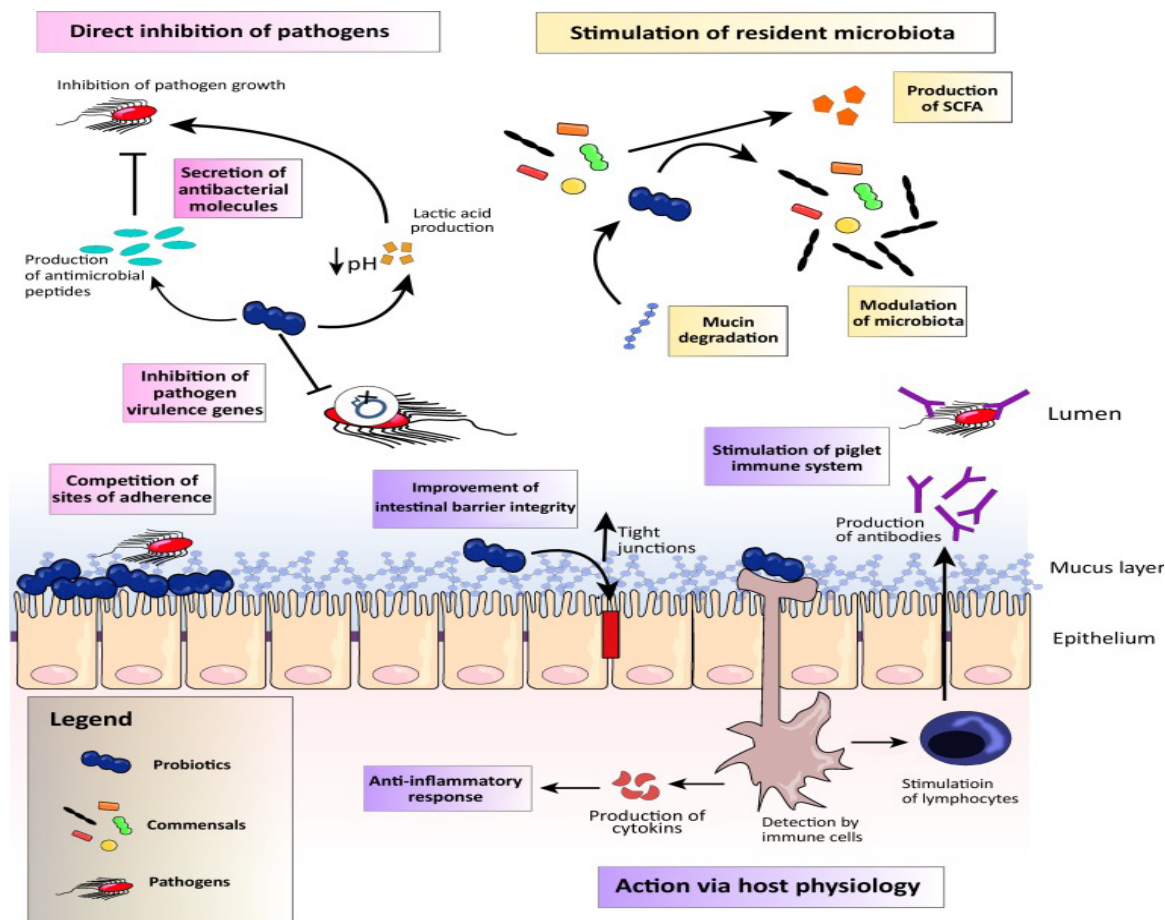
Gut microbiota dysbiosis → Post-weaning diarrhea



- ❖ **Disrupt gut microbiota composition**
- ❖ **More susceptible to pathogenic bacteria, e.g. *Enterotoxigenic Escherichia Coli* (ETEC) → growth inhibition → diarrhea → death**



Probiotics restore gut microbial balance in weaning piglets



- ❖ Balance the gut microbial homeostasis.
- ❖ Competitive exclusion of pathogens and producing antimicrobial substances.
- ❖ Stimulation of the host immune system and improvement in intestinal barrier function.

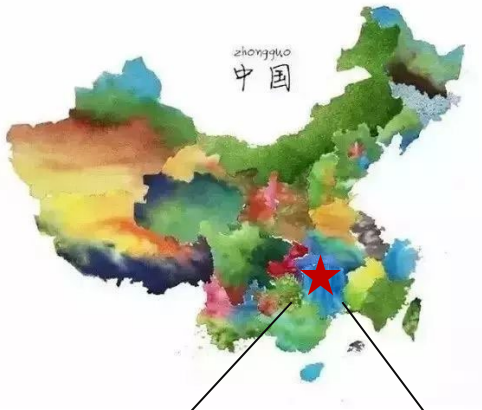
Trends in Microbiology

Gresse R, et al., Trends in microbiology, 2017; Su W, et al., Frontiers in cellular and infection microbiology, 2022

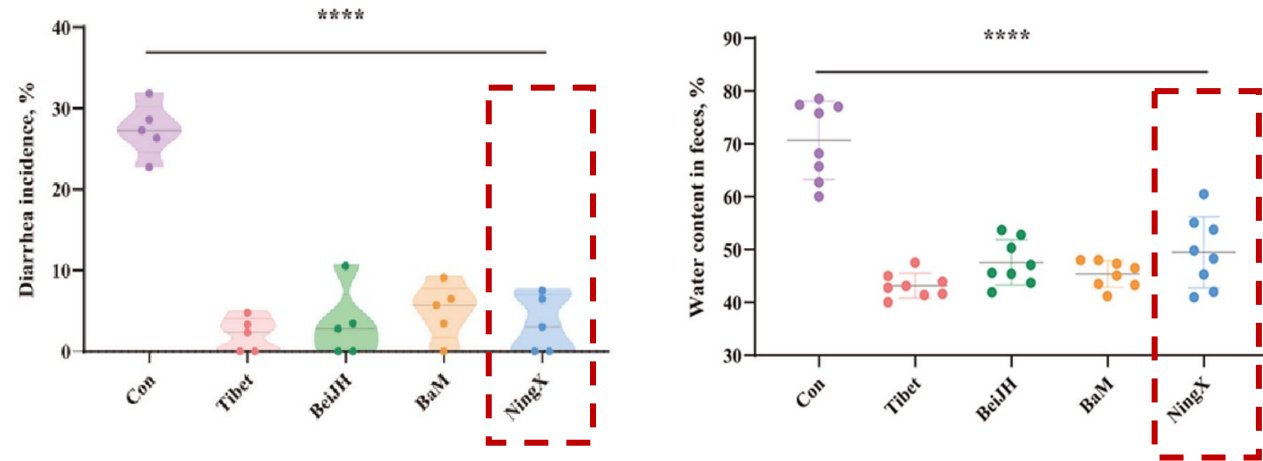
朴誠奮勉 求實創新

Ningxiang pig showed stronger diarrhea resistance

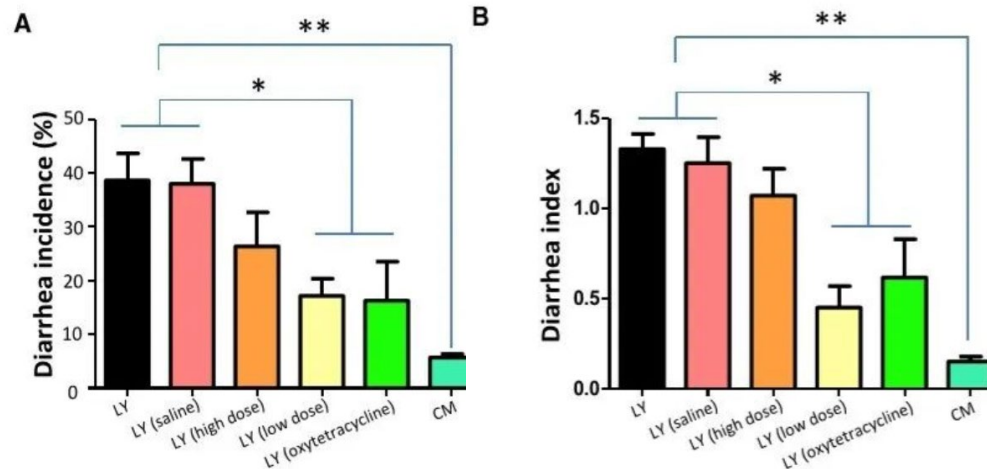
Ningxiang pig Native Chinese breeds



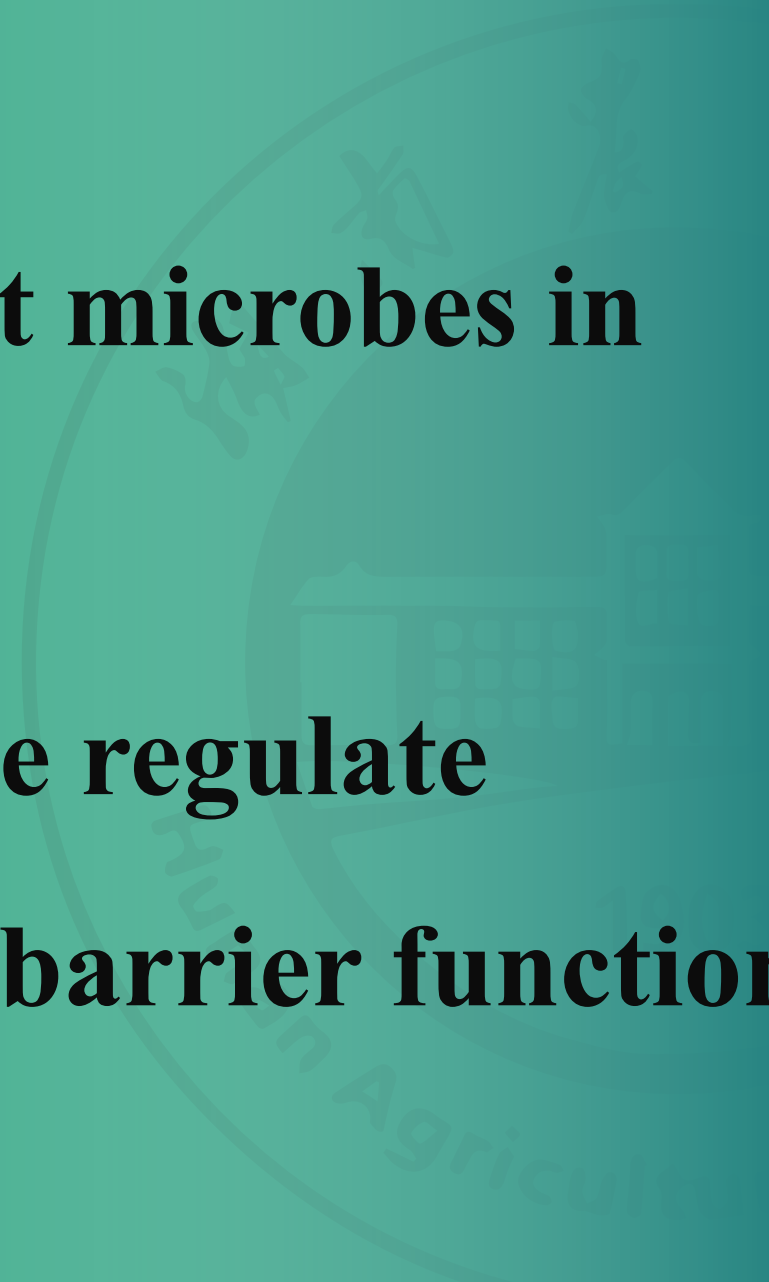
❖ Lower diarrhea incidence



CM: Congjiang miniature piglets LY: Landrace × Yorkshire piglets



❖ Microbiota from local piglet could target the LY piglet to confer diarrhea resistance

- 
- I. What are the differential gut microbes in NingXiang piglets?**
- II. Does the differential microbe regulate diarrhea resistance and gut barrier function?**

Experimental Design

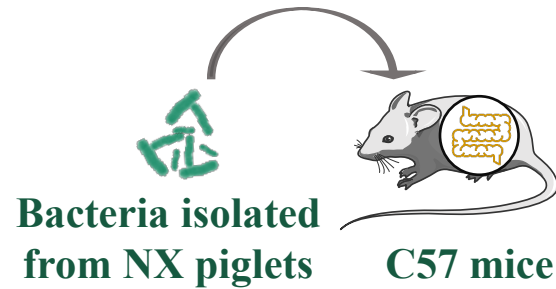
Trial I. Microbial screening

Ningxiang piglet Yorkshire piglet



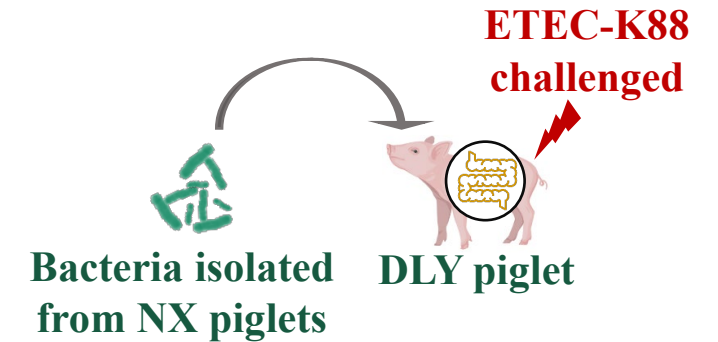
- Screen differential gut microbes
- Isolate the differential microbe

Trial II. Microbial function verification in mice



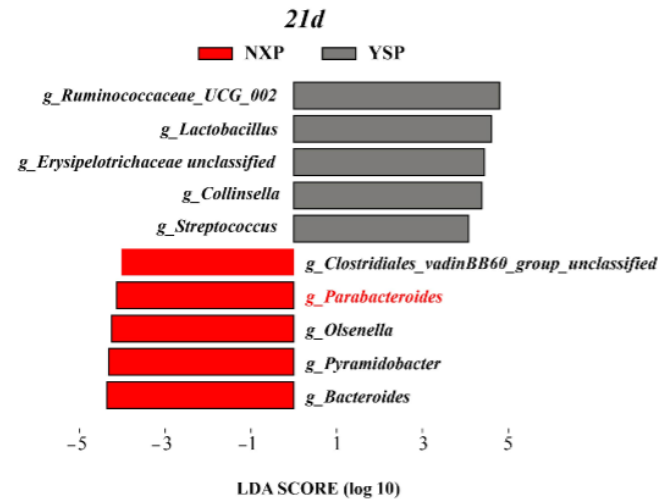
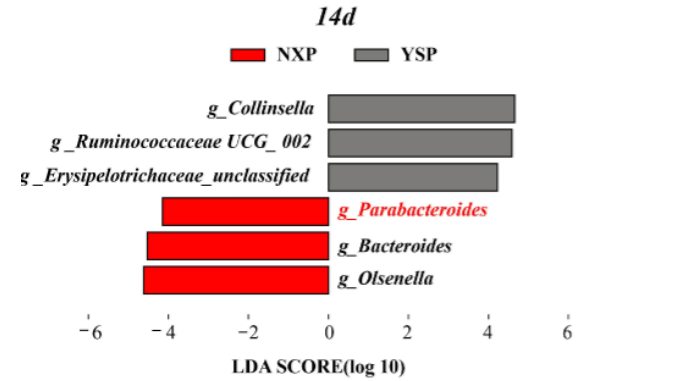
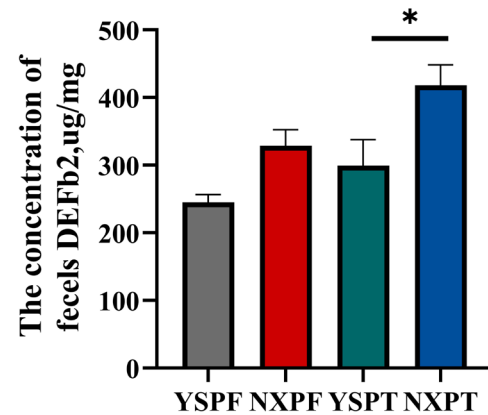
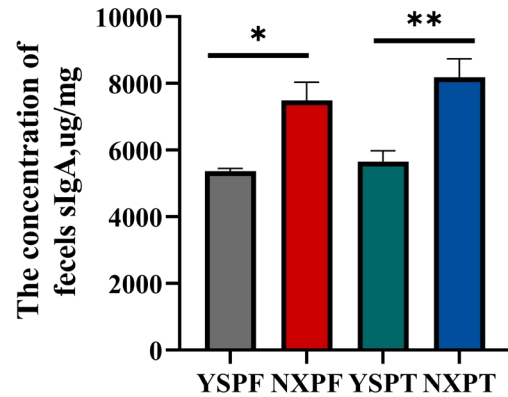
- Transplant the differential bacteria to mice
- Detect the intestinal development and barrier function

Trial II. Microbial function verification in DLY piglets

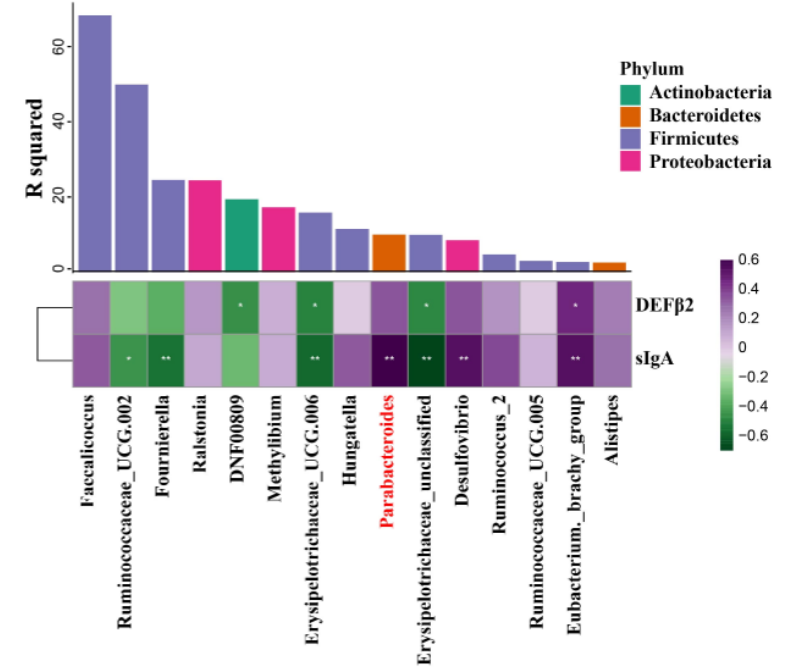


- Transplant the differential bacteria to DLY piglets
- Observe the diarrhea rate and intestinal injury induced by ETEC
- Analyze the gut microbial structure and composition

Parabacteroides were positively correlated with fecal sIgA



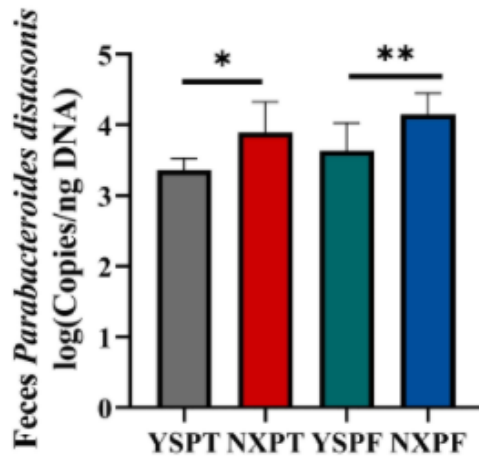
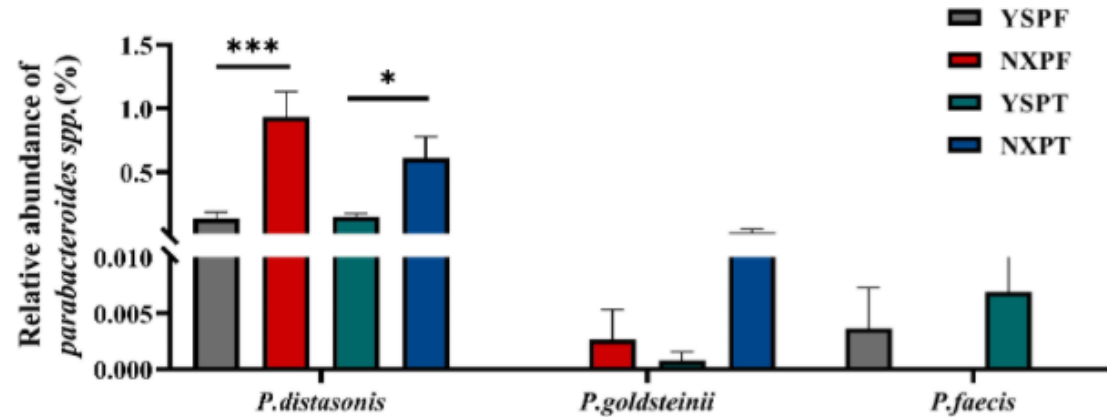
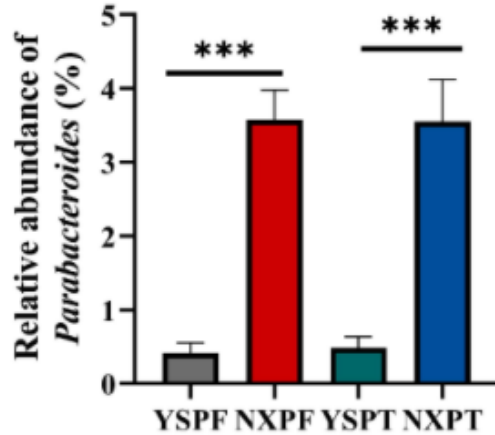
LEfSe analysis



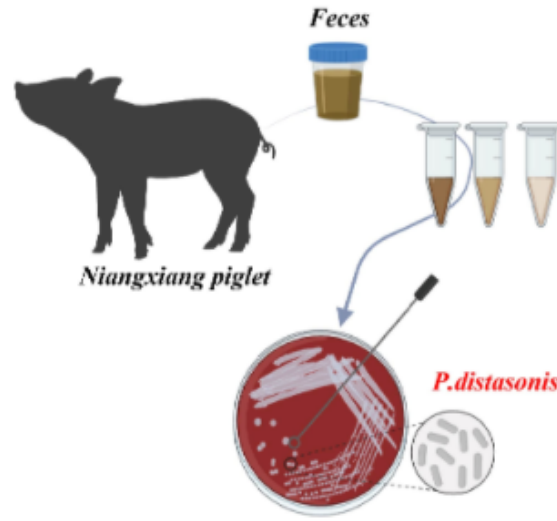
Random forest analysis

- ✓ The fecal sIgA and concentrations in Ningxiang piglets were higher than those of YS piglets.
- ✓ *Parabacteroides* were dominant in Ningxiang piglets and positively correlated with fecal sIgA.

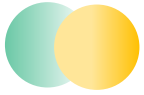
P. distasonis was isolated from the Ningxiang piglet's feces



Absolute abundance



- ✓ The abundance of *P. distasonis* was higher than *P. goldsteinii* and *P. faecis* in Ningxiang piglets.
- ✓ A higher presence of *P. distasonis* in Ningxiang piglets at 14 d and 21 d of age.



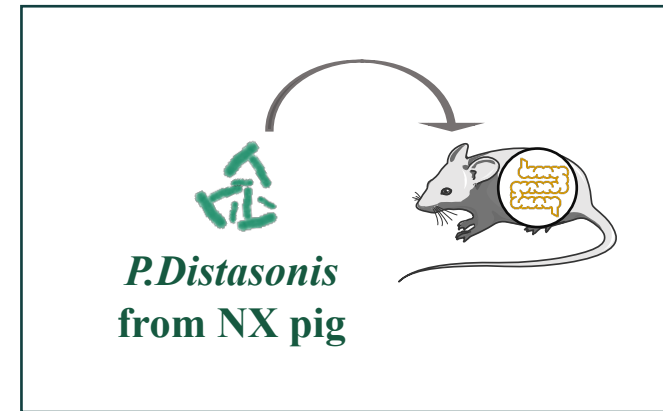
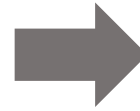
Trial I. Differential microbial screening

Ningxiang piglet Yorkshire piglet

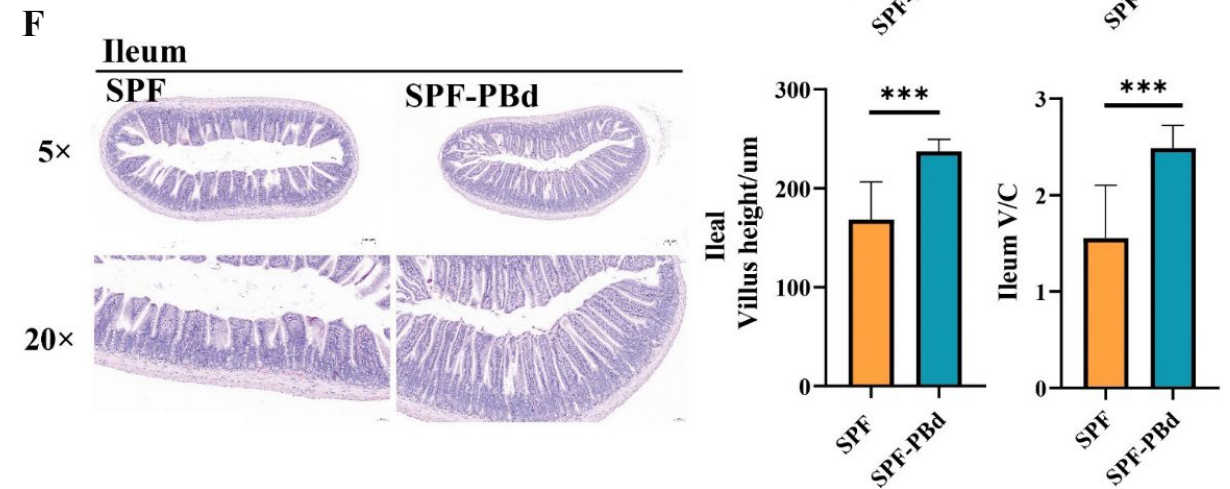
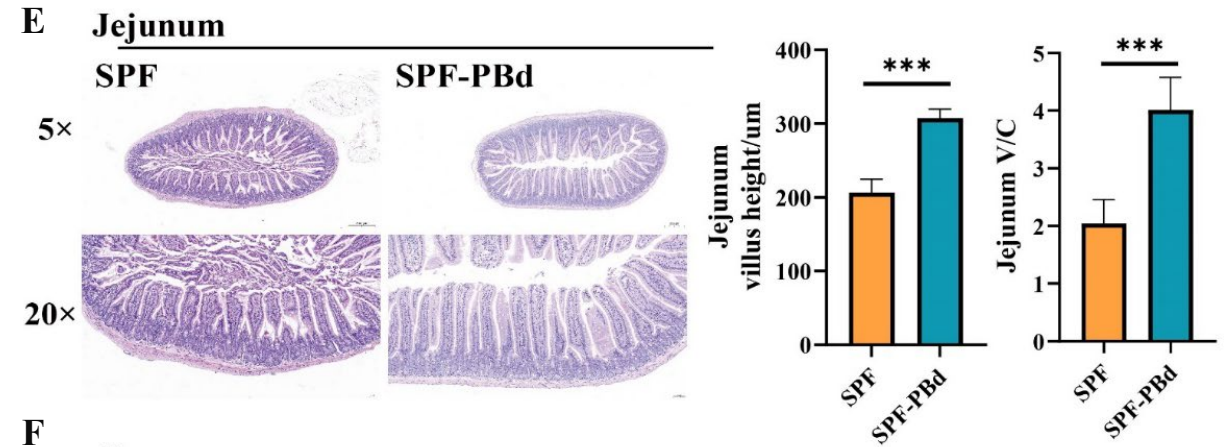
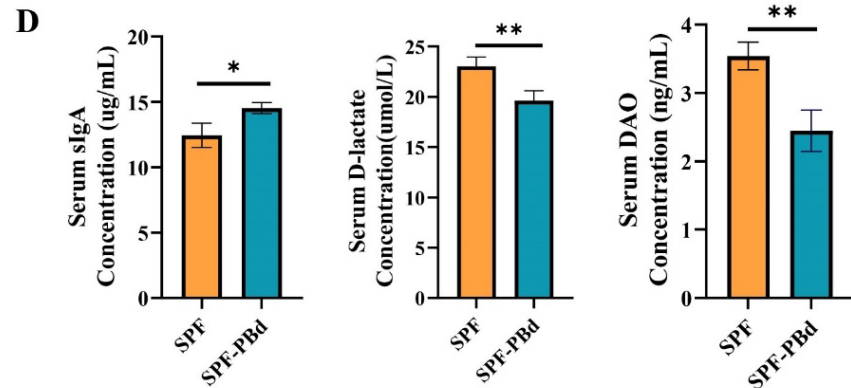
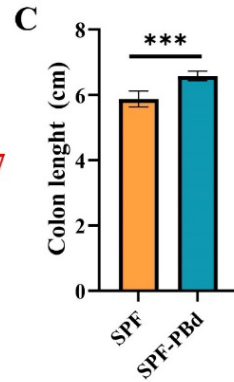
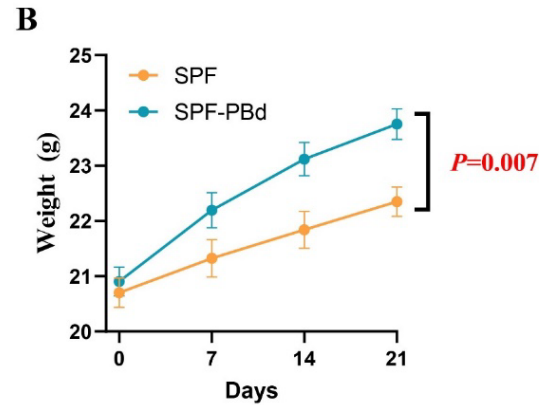
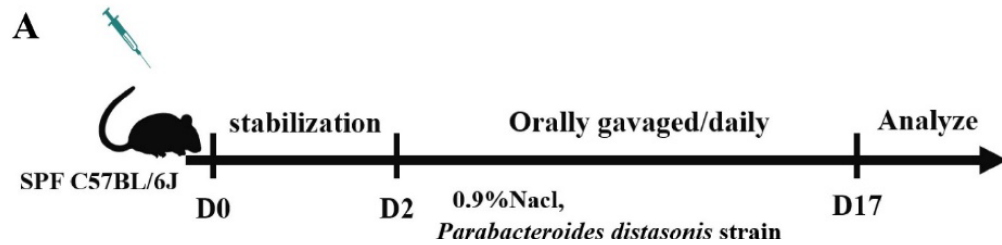


- ✓ *Parabacteroides* were dominant in Ningxiang piglets
- ✓ *Parabacteroides* were positively correlated with fecal sIgA
- ✓ *P. distasonis* was isolated from Ningxiang piglet feces.

Does *P.distasonis* have a beneficial effect on intestinal development or barrier function?

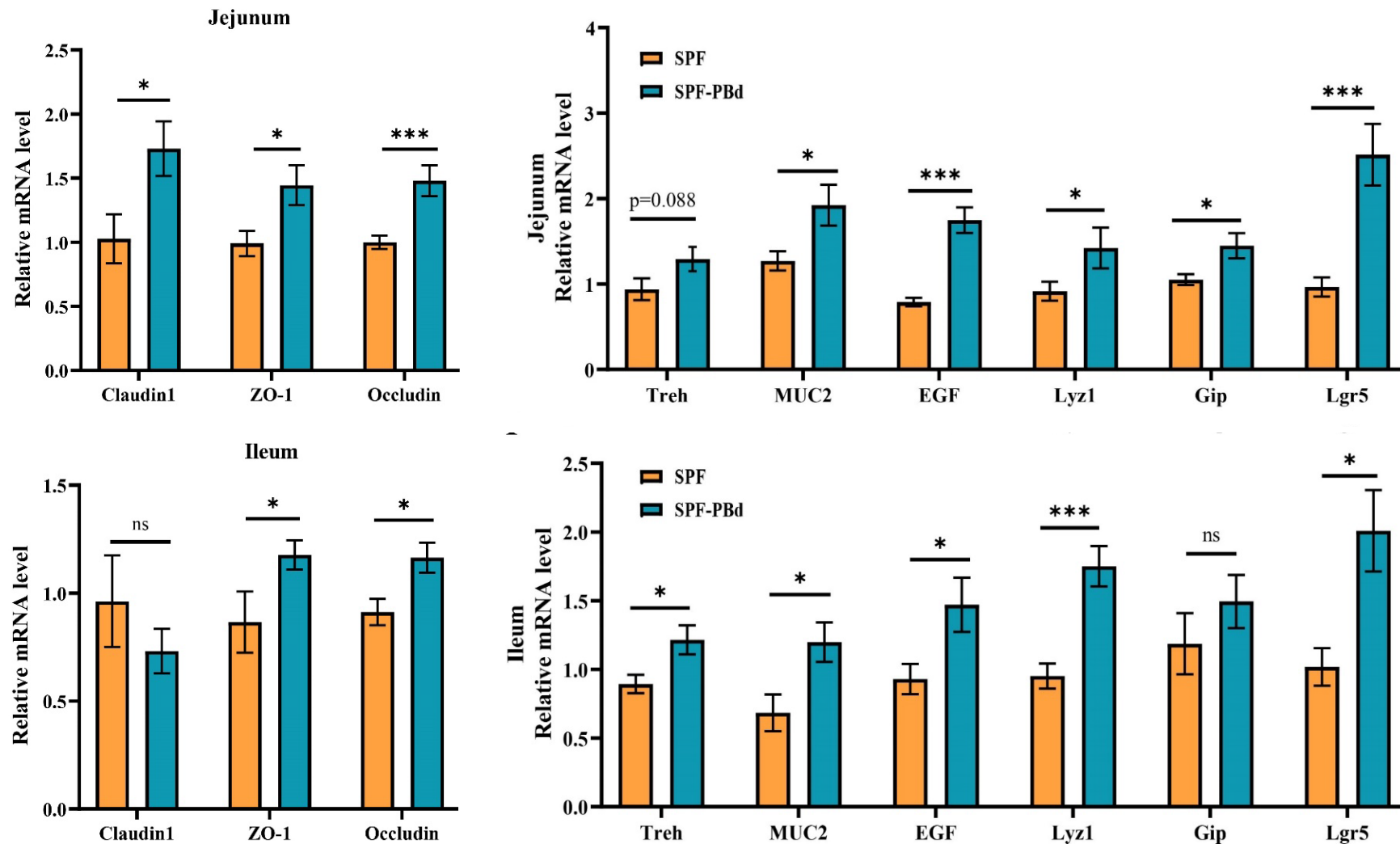


P. distasonis improved intestinal barrier integrity and development

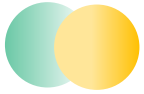


- ✓ *P. distasonis* administration promoted the body weight gain of mice.
- ✓ *P. distasonis* increased the serum sIgA level and intestinal V/C ratio, and decreased the gut barrier permeability.

P.distasonis improved intestinal barrier integrity and development



- ✓ *P.distasonis* administration increased the intestinal tight junction gene expressions in mice.
- ✓ *P.distasonis* might promote the intestinal development.

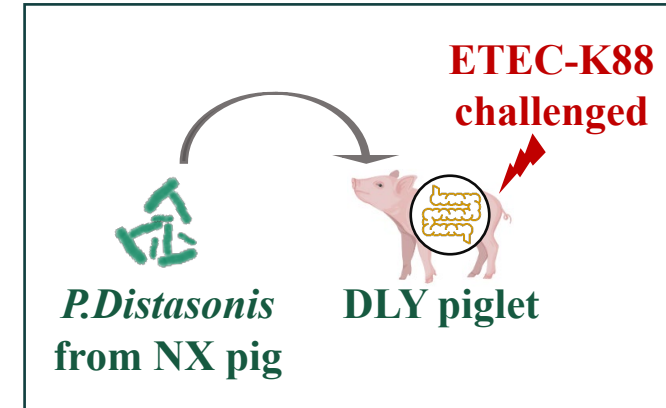
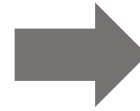


Trial II. Microbial function verification in mice

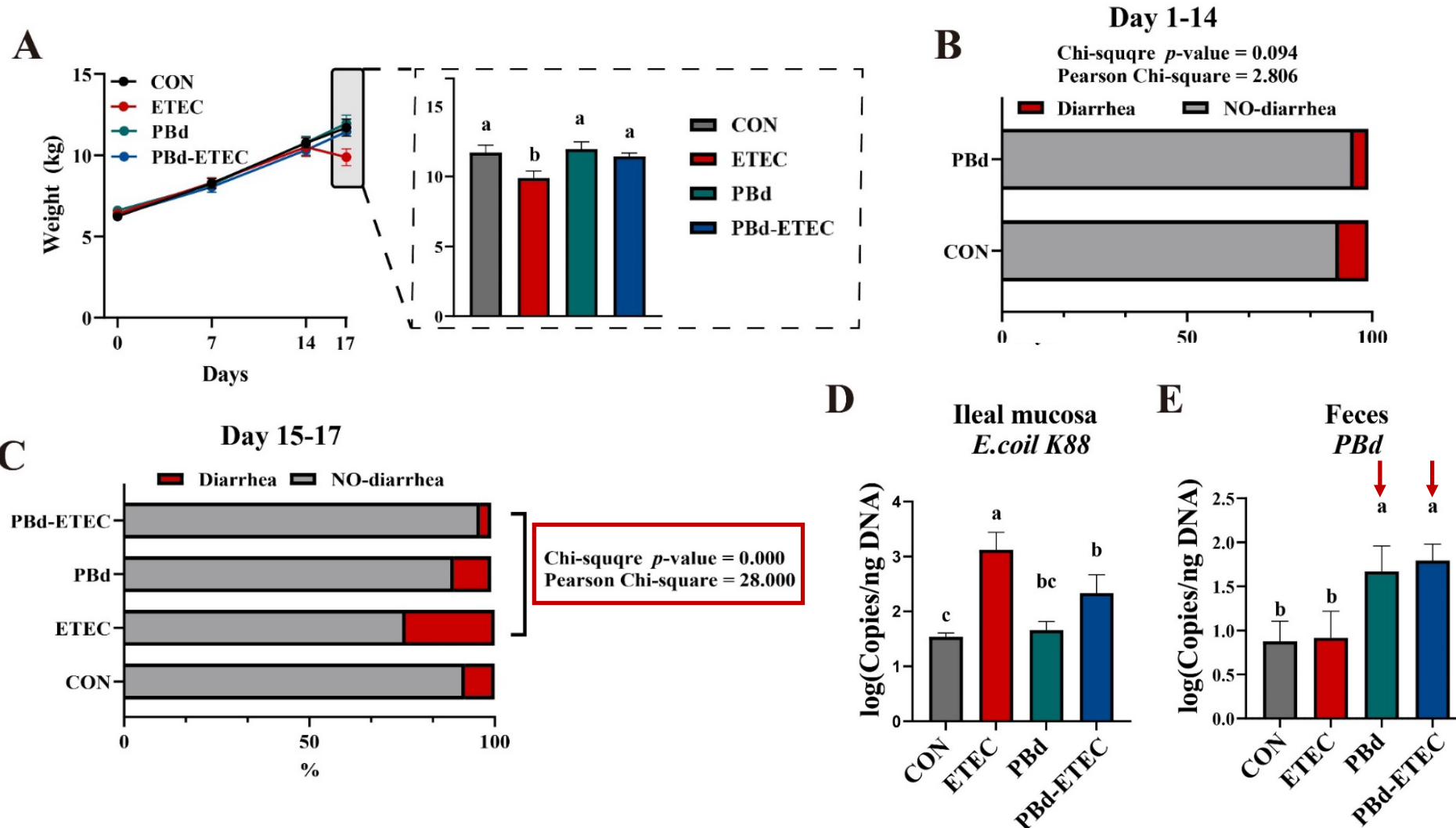


- ✓ *P. distasonis* increases the body weight of mice
- ✓ *P. distasonis* enhances the serum sIgA concentrations
- ✓ *P. distasonis* promotes the intestinal integrity and development

Does *P. distasonis* prevent diarrhea in DLY piglets?

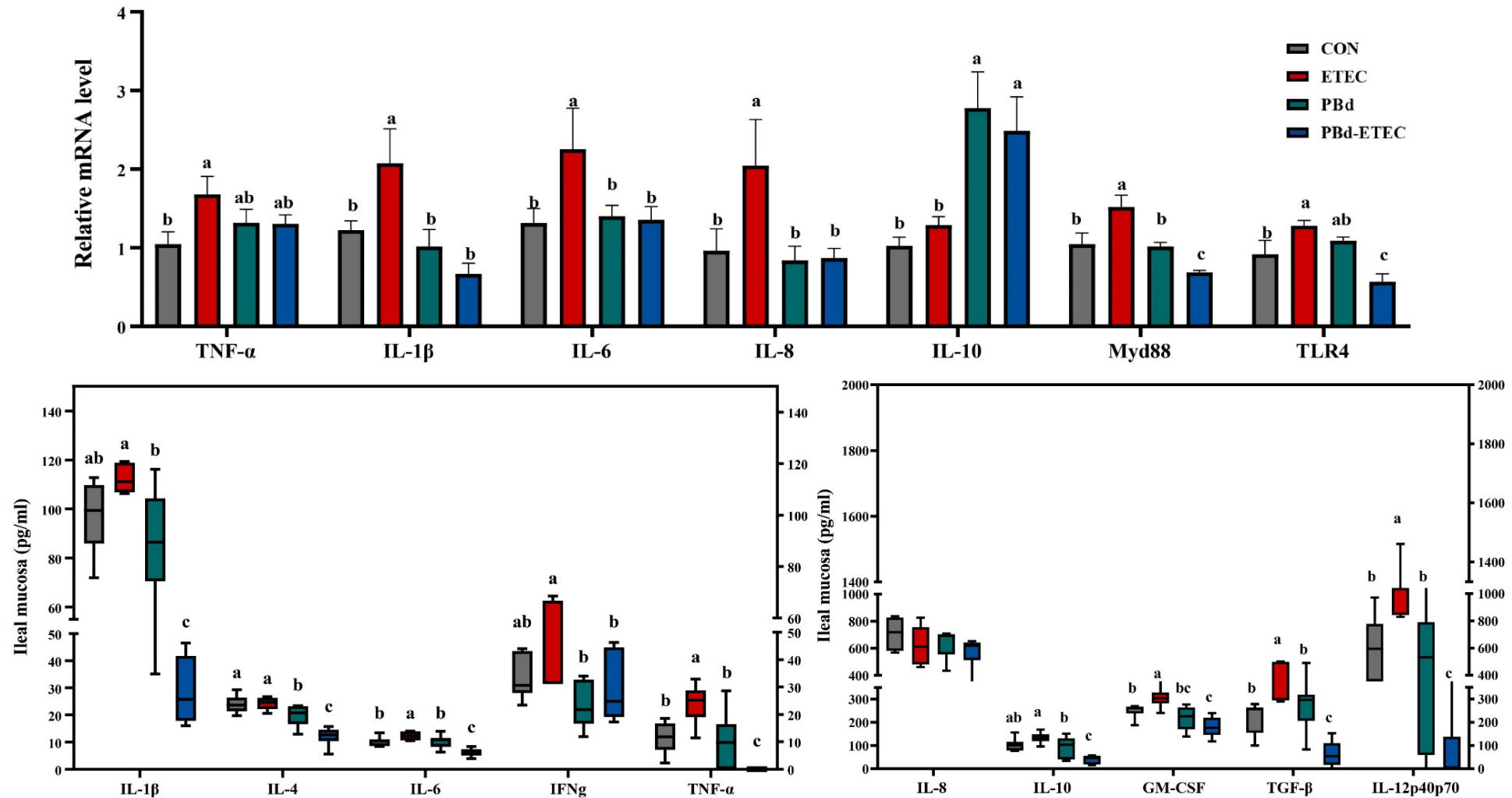


P. distasonis ameliorated diarrhea induced by ETEC infection



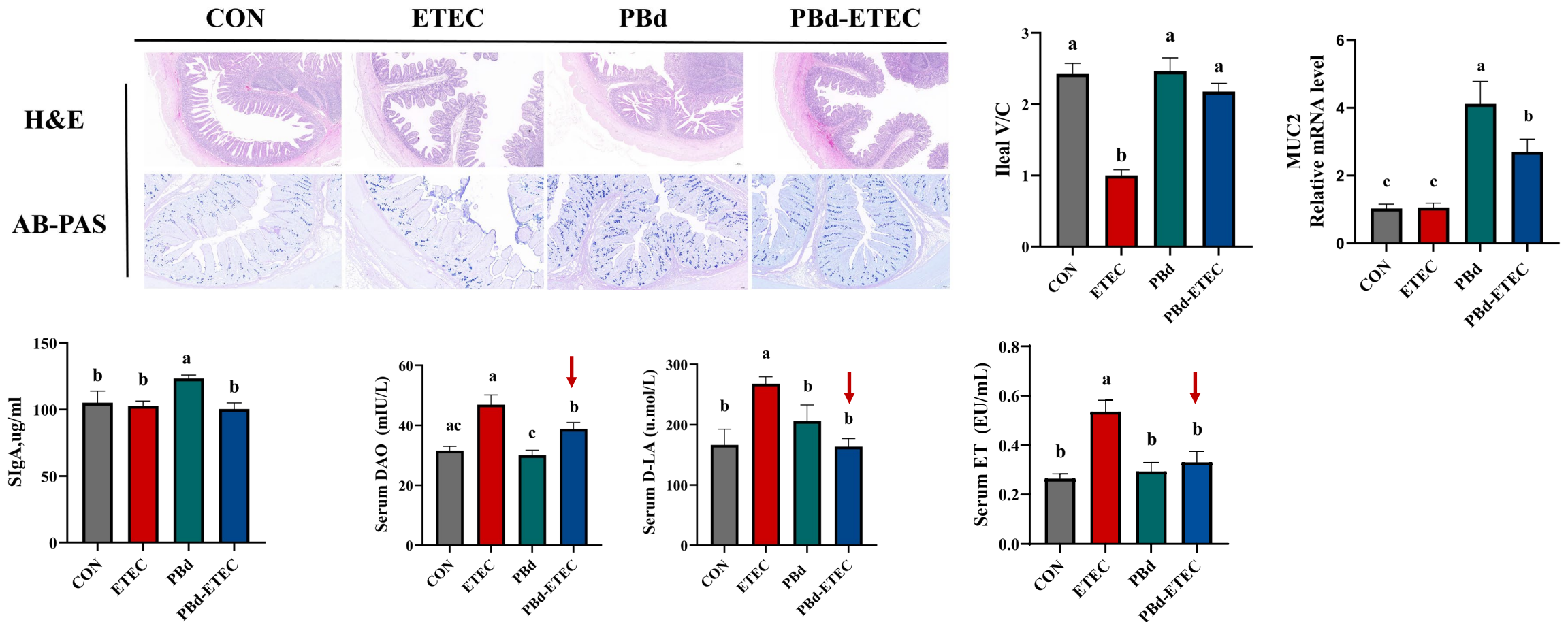
- ✓ *P. distasonis* administration alleviated the body weight loss and decreased the diarrhea rate after ETEC infection.
- ✓ *P. distasonis* could colonized in the gut of DLY piglets and inhibited the ETEC colonization.

P.distasonis protected against ETEC-induced inflammation



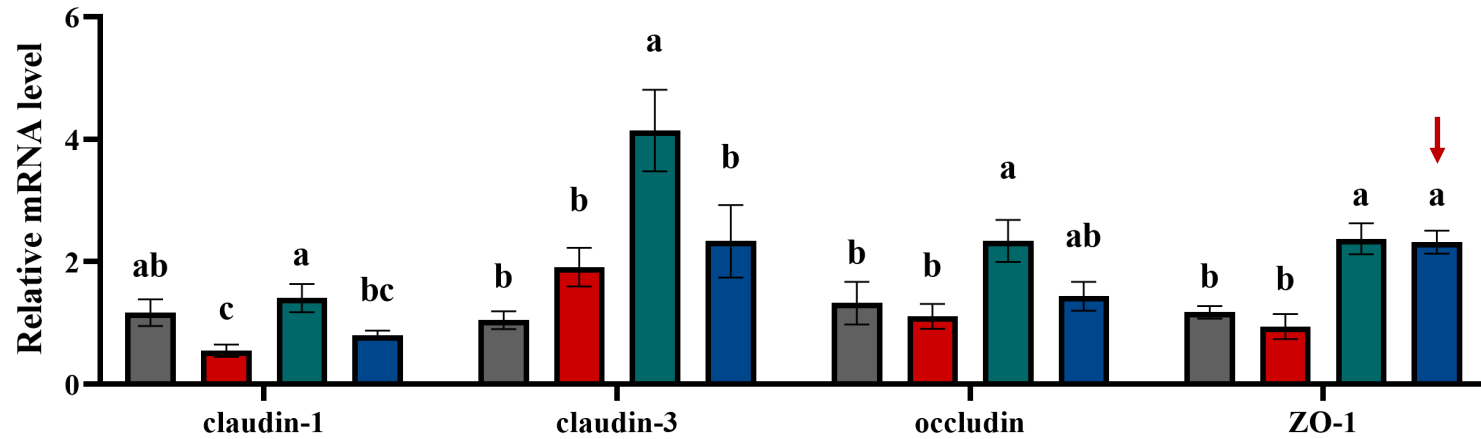
✓ *P.distasonis* administration decreased the pro-inflammatory cytokines' expression and levels of ileum in ETEC-challenged piglets.

P.distasonis improved intestinal barrier integrity in piglet

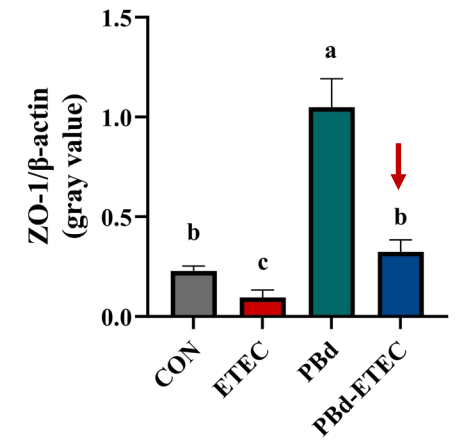
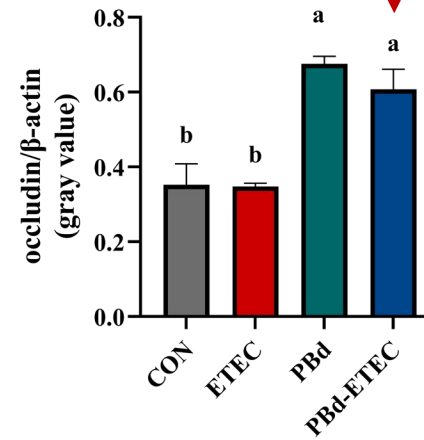
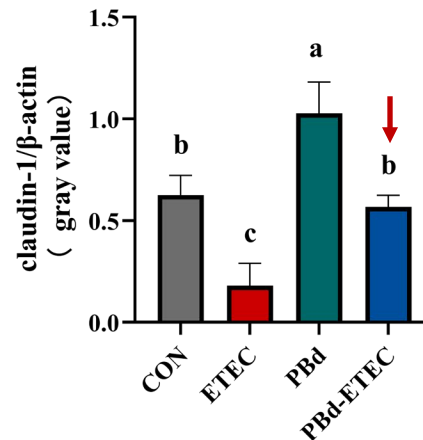
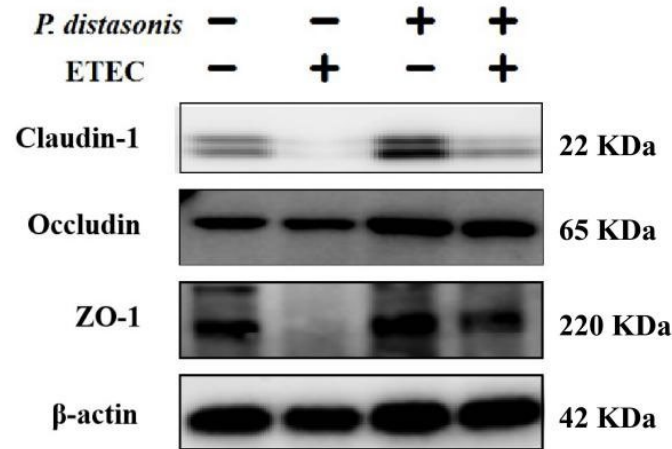


- ✓ *P.distasonis* improved ileal barrier morphology, and increased Muc2 expression and sIgA level of piglets with or without ETEC infection.
- ✓ *P.distasonis* significantly decreased DAO, D-LA and ET levels in ETEC-challenged piglets.

P.distasonis improved intestinal barrier integrity in piglet



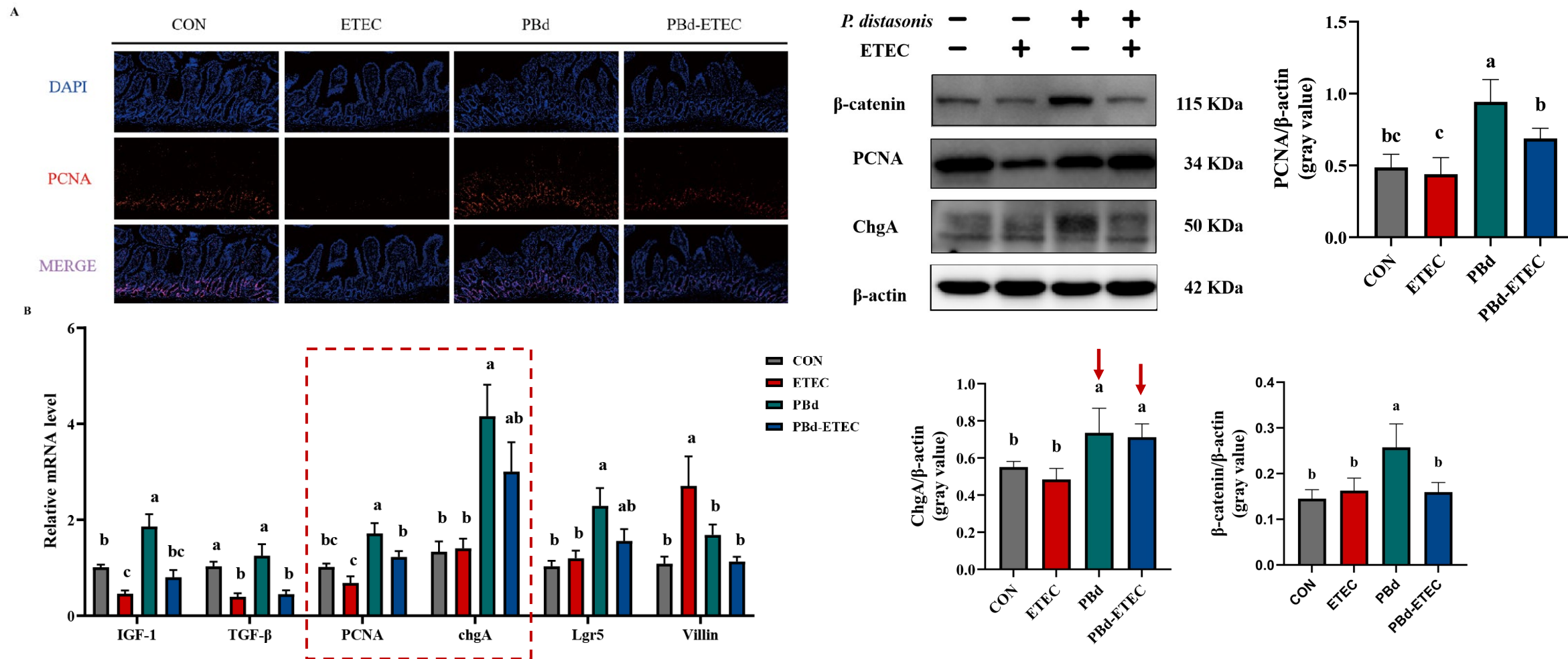
G



✓ *P.distasonis* increased the intestinal tight junction mRNA expressions and protein abundances, which indicated that *P.distasonis* might block the invasion of enterotoxin by enhancing the integrity of intestinal barrier.

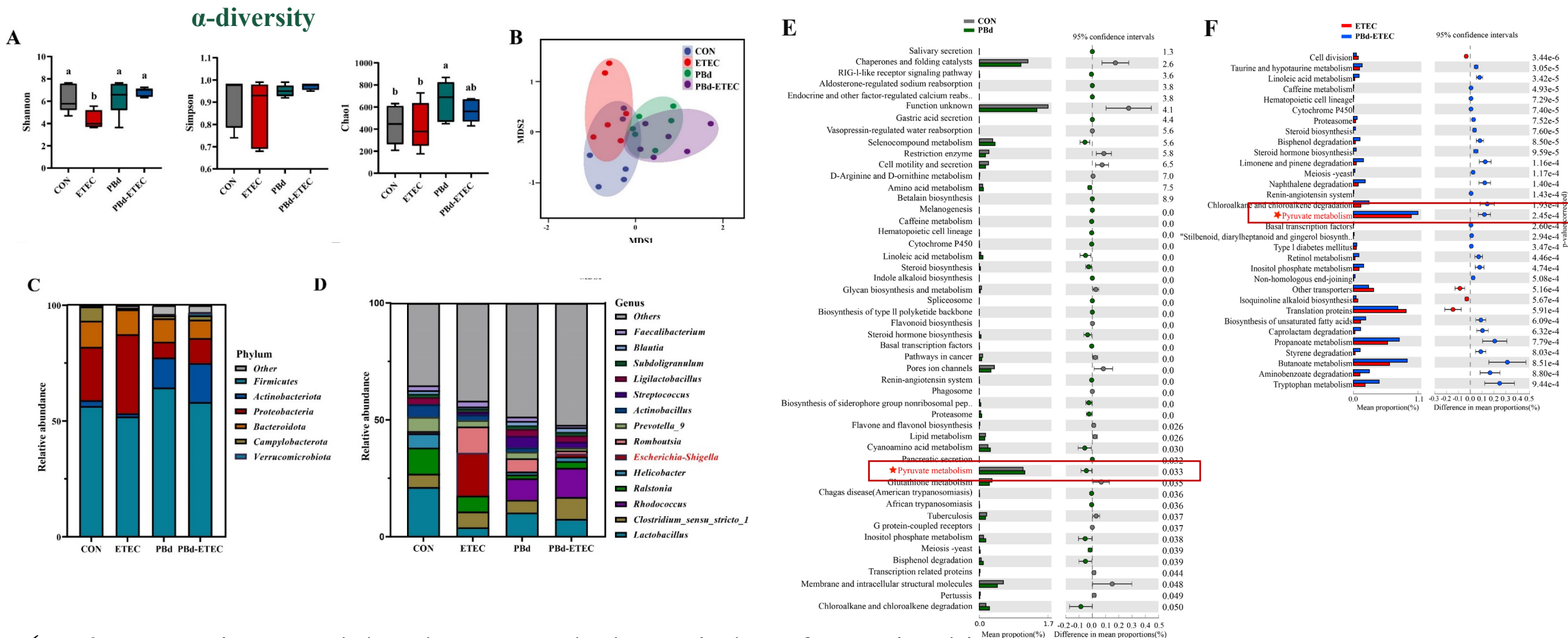


P.distasonis promoted intestinal development in piglet



✓ *P.distasonis* enhanced the cell proliferation and differentiation related genes and protein expressions of enterocyte in piglets with or without ETEC infection.

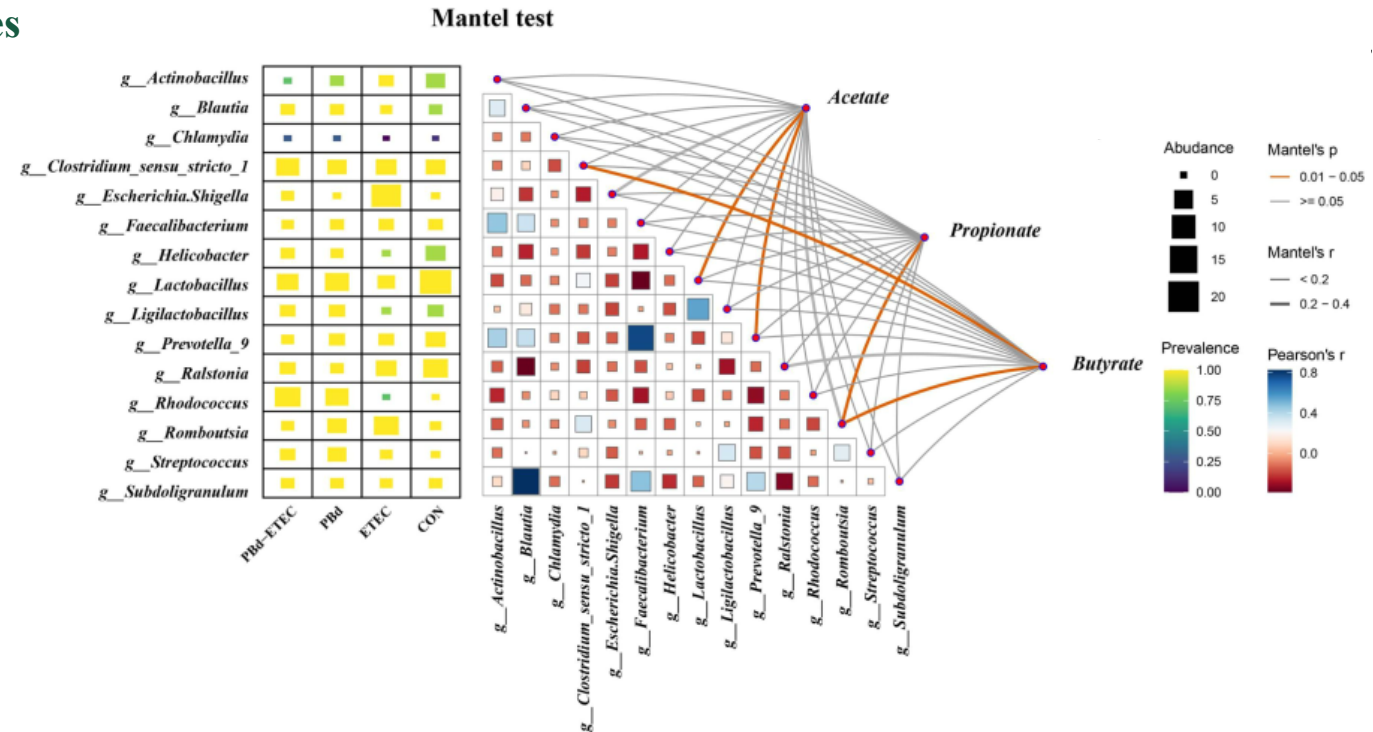
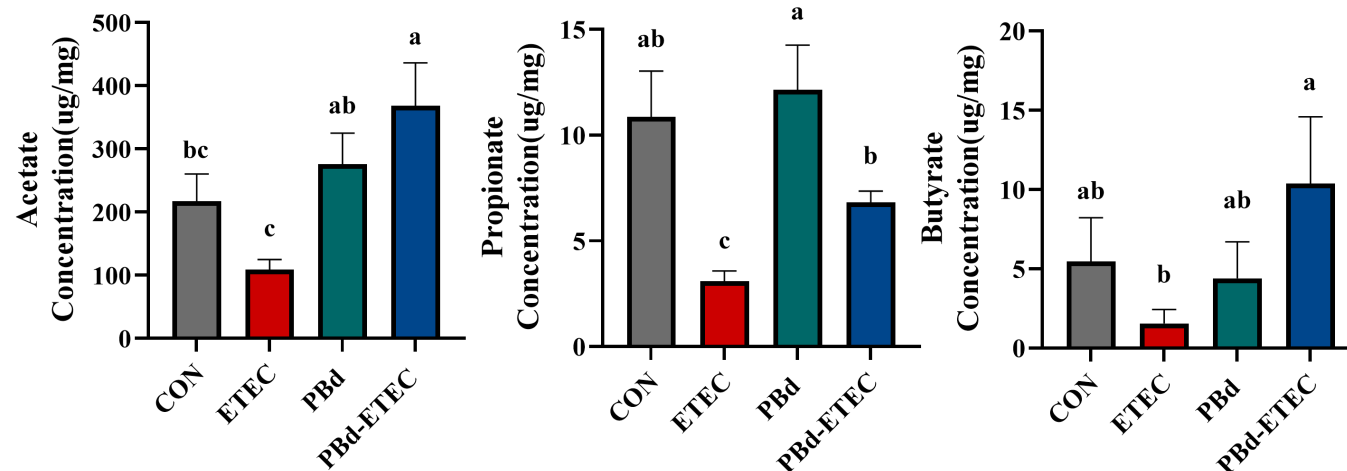
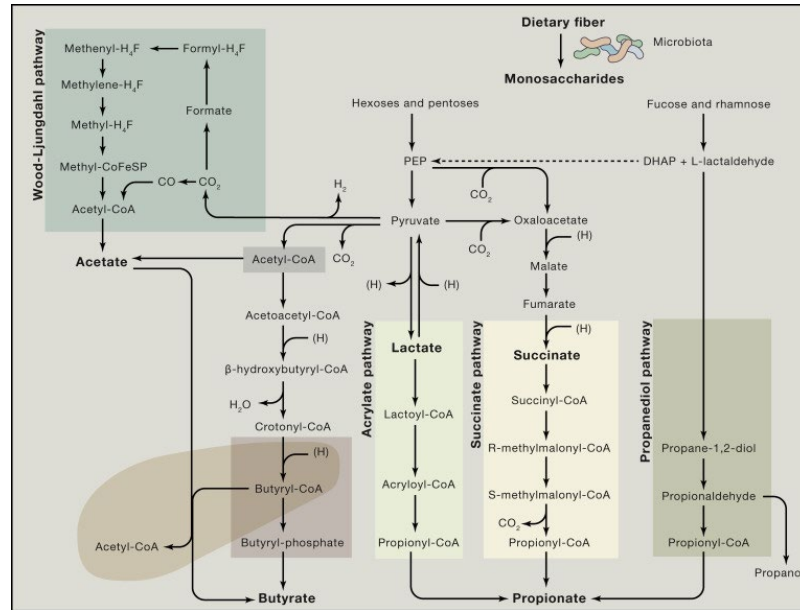
P. distasonis affected the gut microbial composition in piglets



- ✓ *P. distasonis* increased the Shannon and Chao-1 index of gut microbiota.
- ✓ NMDS plot showed Pbd-ETEC group formed a distinct cluster separated from the ETEC group.
- ✓ KEGG analysis indicated *P. distasonis* might mainly participated in microbial **pyruvate metabolism**.

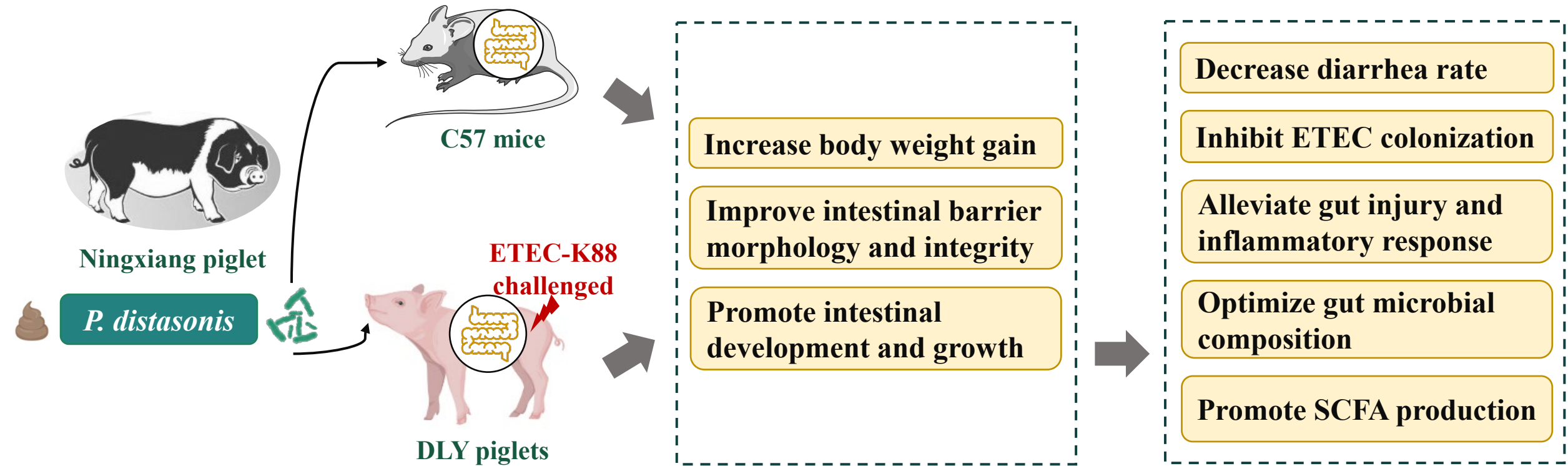
P. distasonis raised SCFAs concentration of intestinal content

Pyruvate can be metabolized into SCFAs by gut microbes



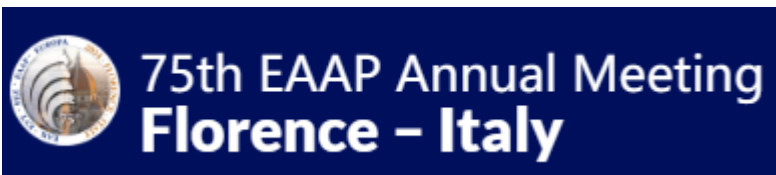
✓ *P. distasonis* might be involved in microbial SCFAs production.

In summary





Acknowledgement



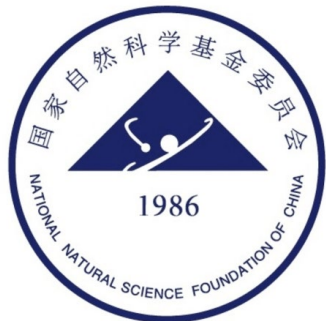
Dr. Yulong Yin, ISA and HUNAU

Dr. Bie Tan, HUNAU

Qu. XXTG group, HUNAU

**ANIMAL NUTRITIONAL GENOME AND
GERMPLASM INNOVATION RESEARCH CENTER**

**NATIONAL NATURAL SCIENCE FOUNDATION OF
CHINA**





湖南农业大学
HUNAN AGRICULTURAL UNIVERSITY

Thank You!



75th EAAP Annual Meeting
Florence - Italy