UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Use of Feed Additives in Diets for Pigs

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Overview

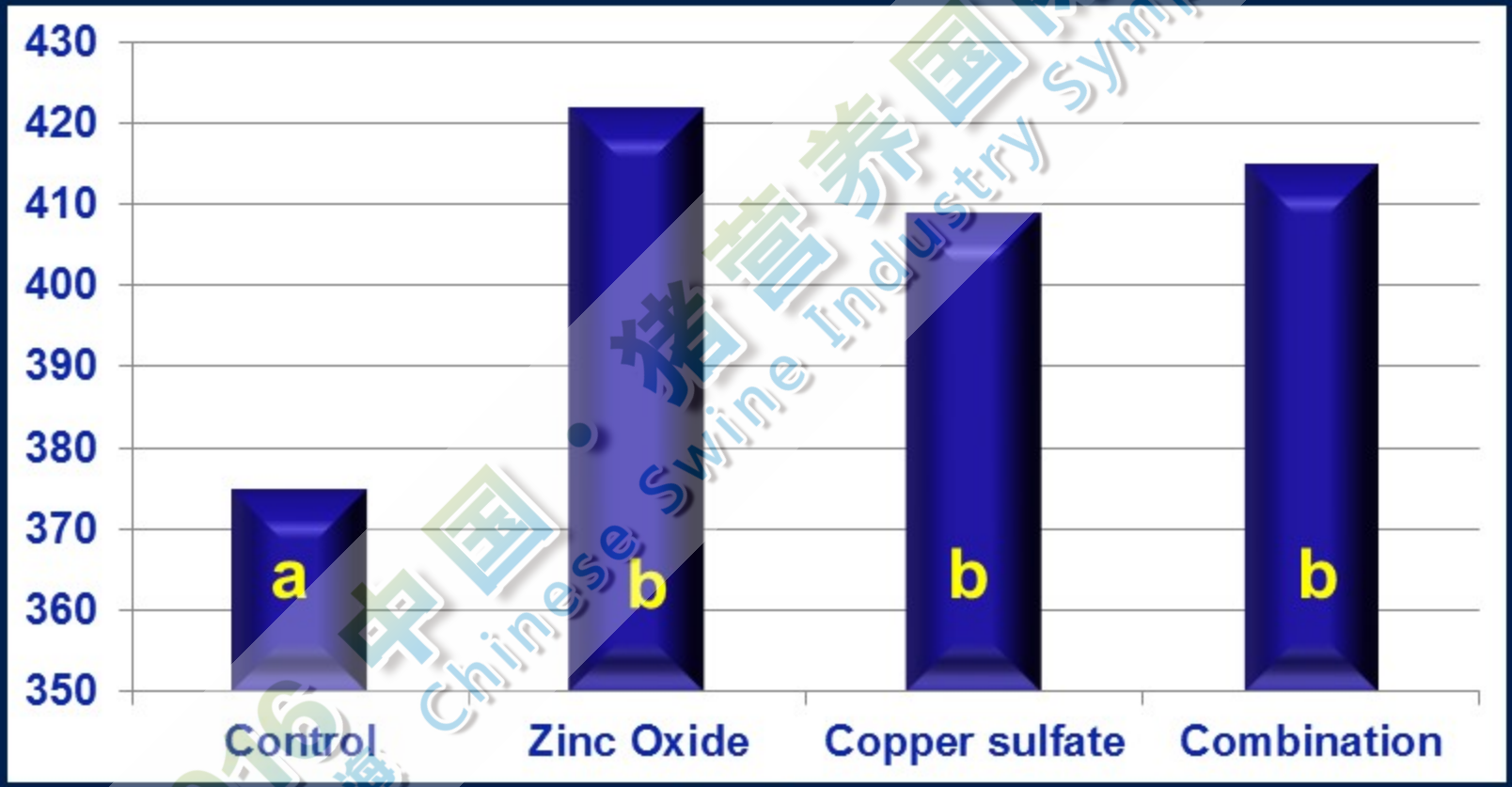
- Copper and Zinc
- Prebiotics and direct fed microbials
- Nucleotides and Plant Extracts

General Mode of Action

Modify Gut Microbiota

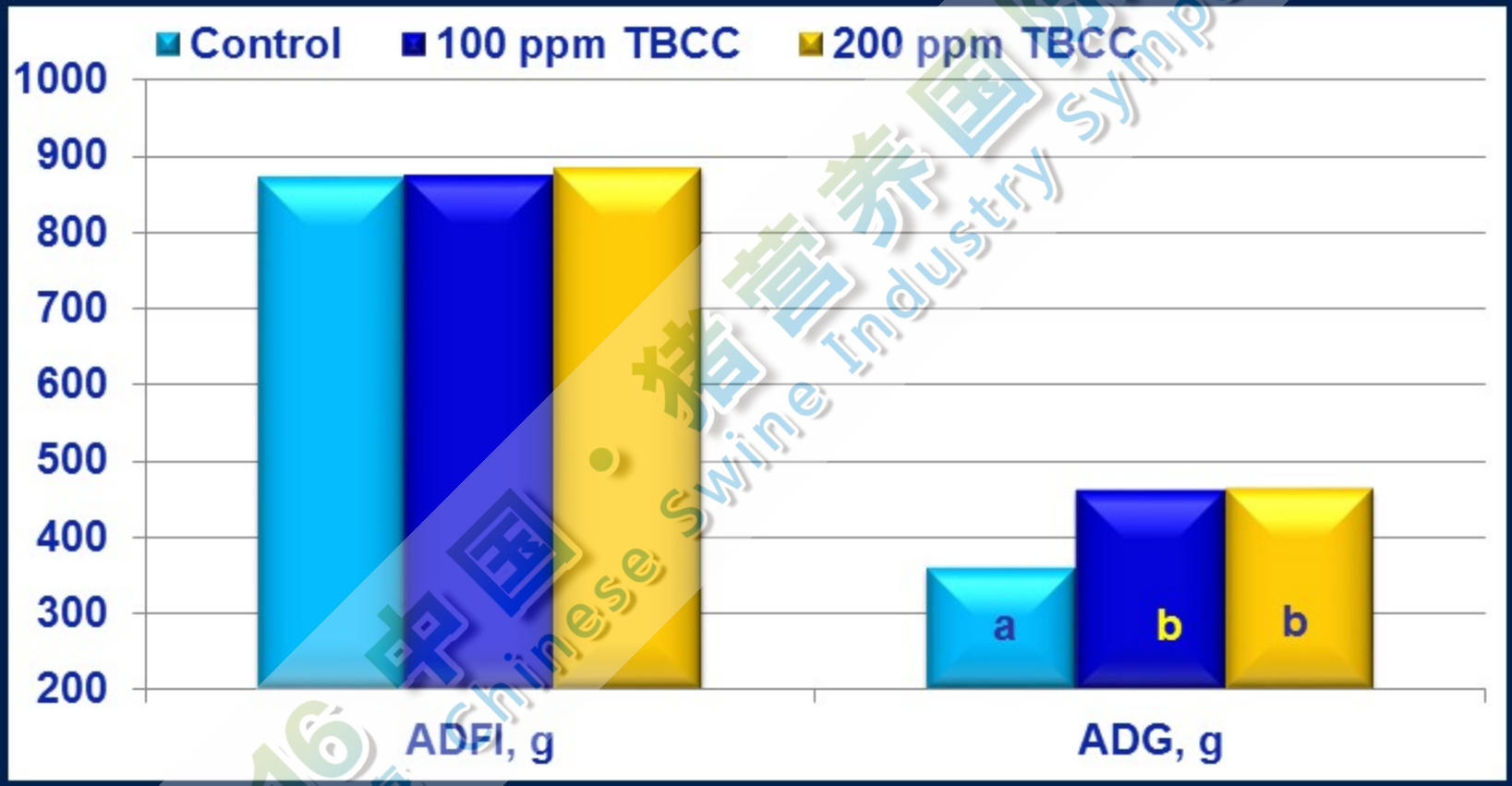
Improved Intestinal Health

Copper and Zinc, ADG, g/d



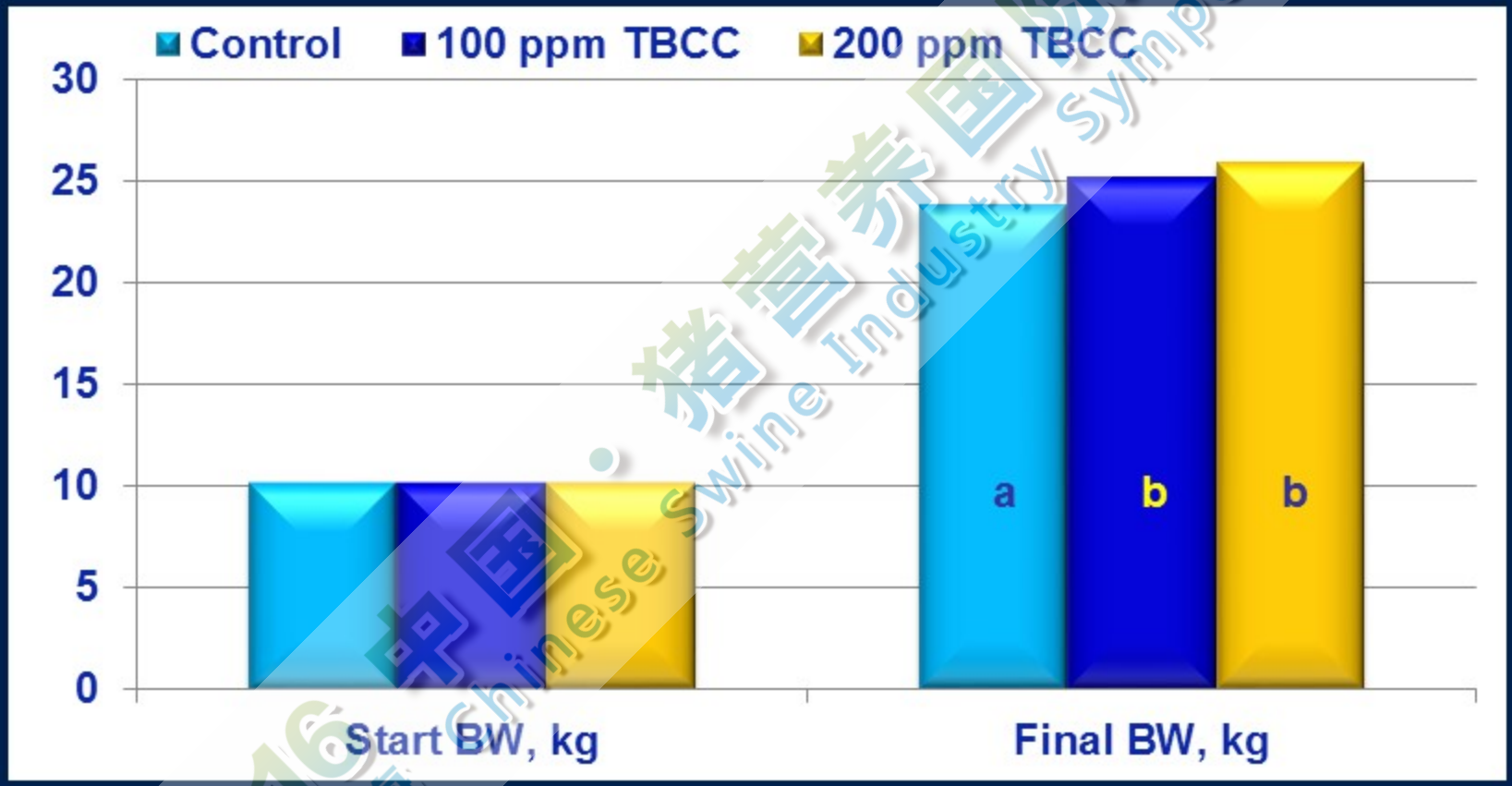
Hill et al., 2000

Effect of Tribasic Copper Chloride



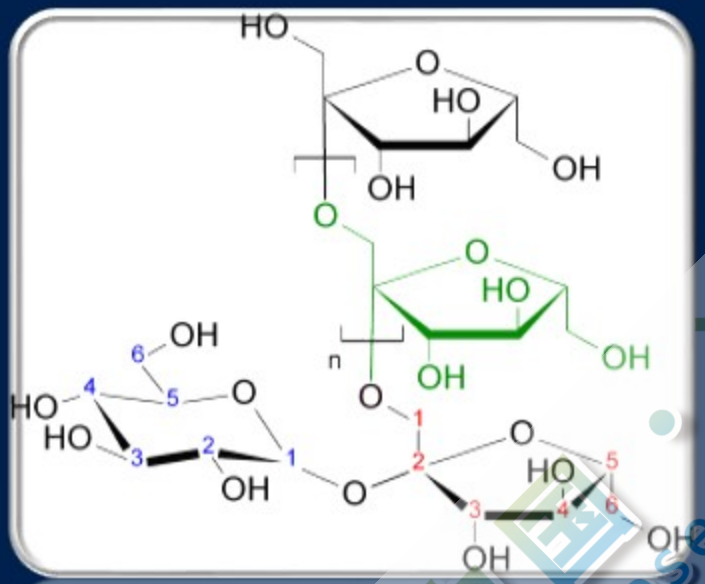
Espinosa and Stein, 2016

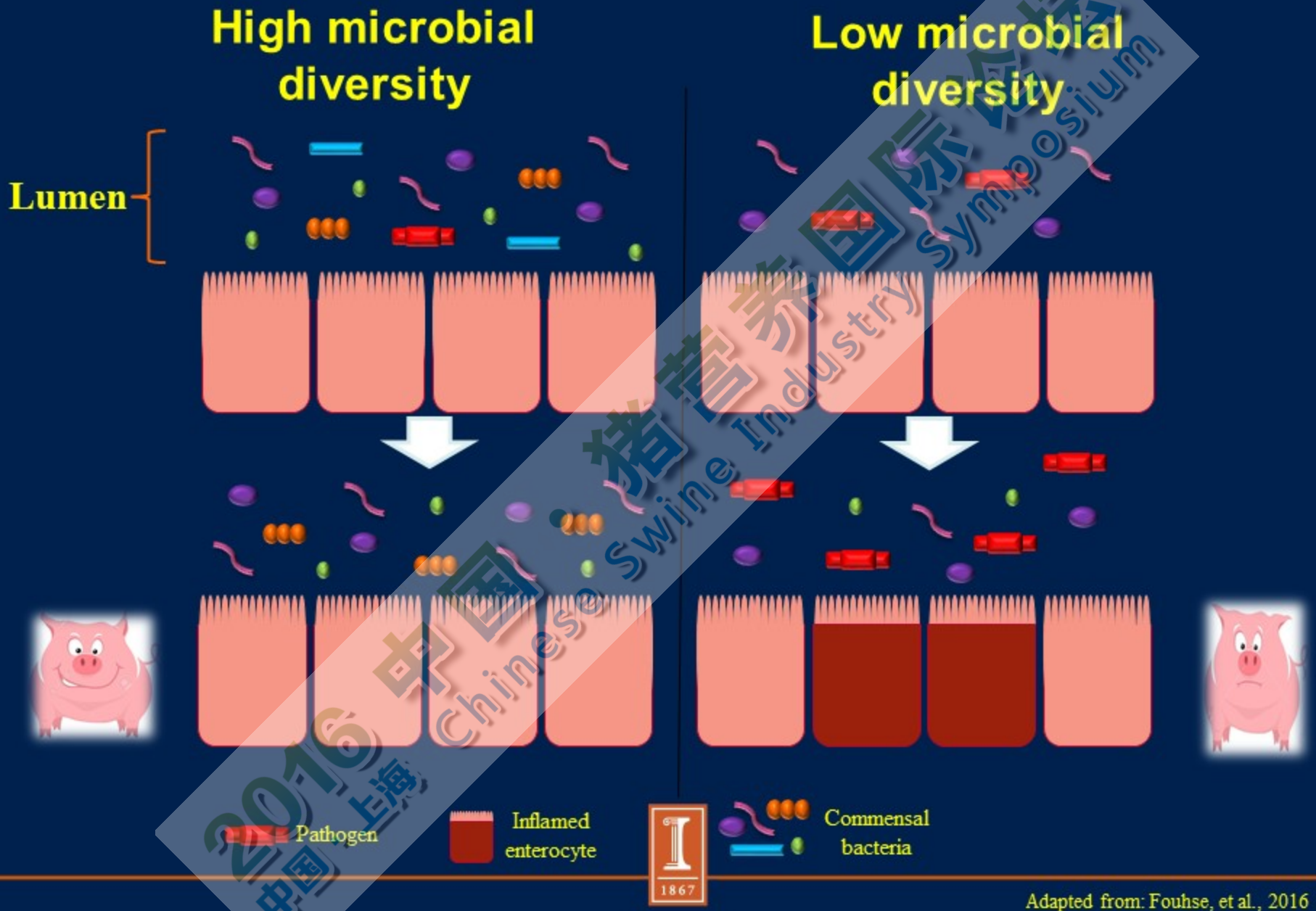
Effect of Tribasic Copper Chloride



Espinosa and Stein, 2016

Prebiotics and Probiotics





Adapted from: Fouhse, et al., 2016

Carbohydrates, overview

- Monosac.
- Disaccharides
  - Sucrose
  - Lactose
  - Maltose
  - Celliobiose
  - Gentiobiose
- Oligosaccharides
  - α-GOS
  - FOS
  - TOS
  - MOS
- Polysaccharides
  - Starch, Glycogen
  - Non-starch polysaccharides

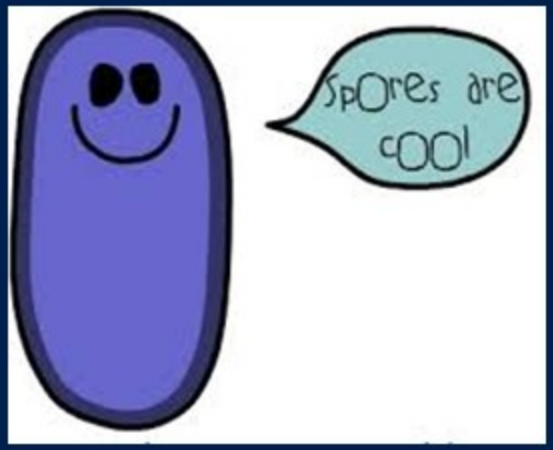
Mode of action

① Growth of bacteria → ↑ Lactic + acetic acid → ↓ pH in intestine

② Fermentation → ↑ SCFA → ↓ Pathogens

Direct-fed Microbials

- Live naturally occurring microorganisms
- *Bacillus*-based DFM
  - Spore-forming

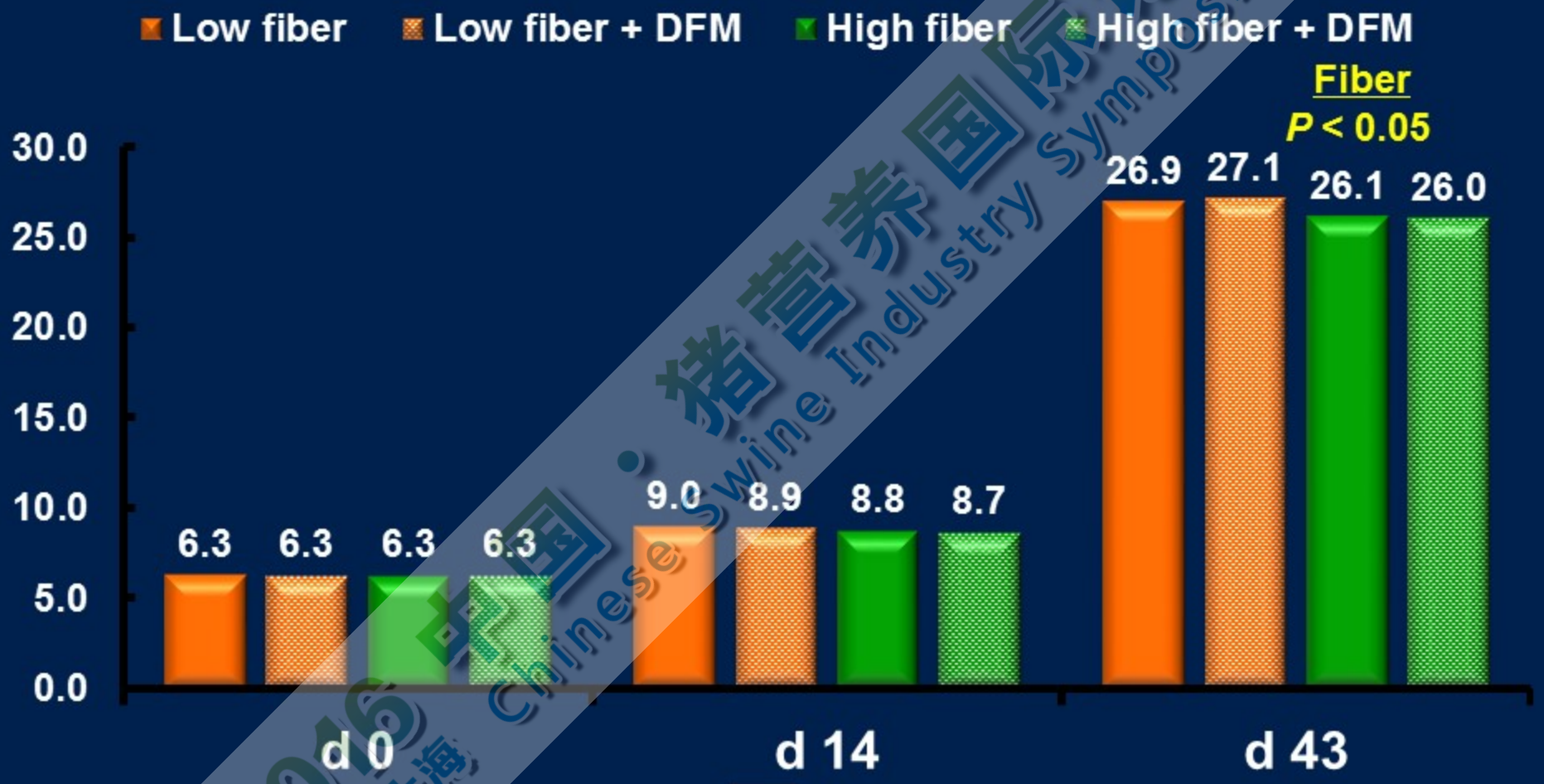


Effect of 3-strain DFM

Low or high fiber diets – d 1 to 42 PW

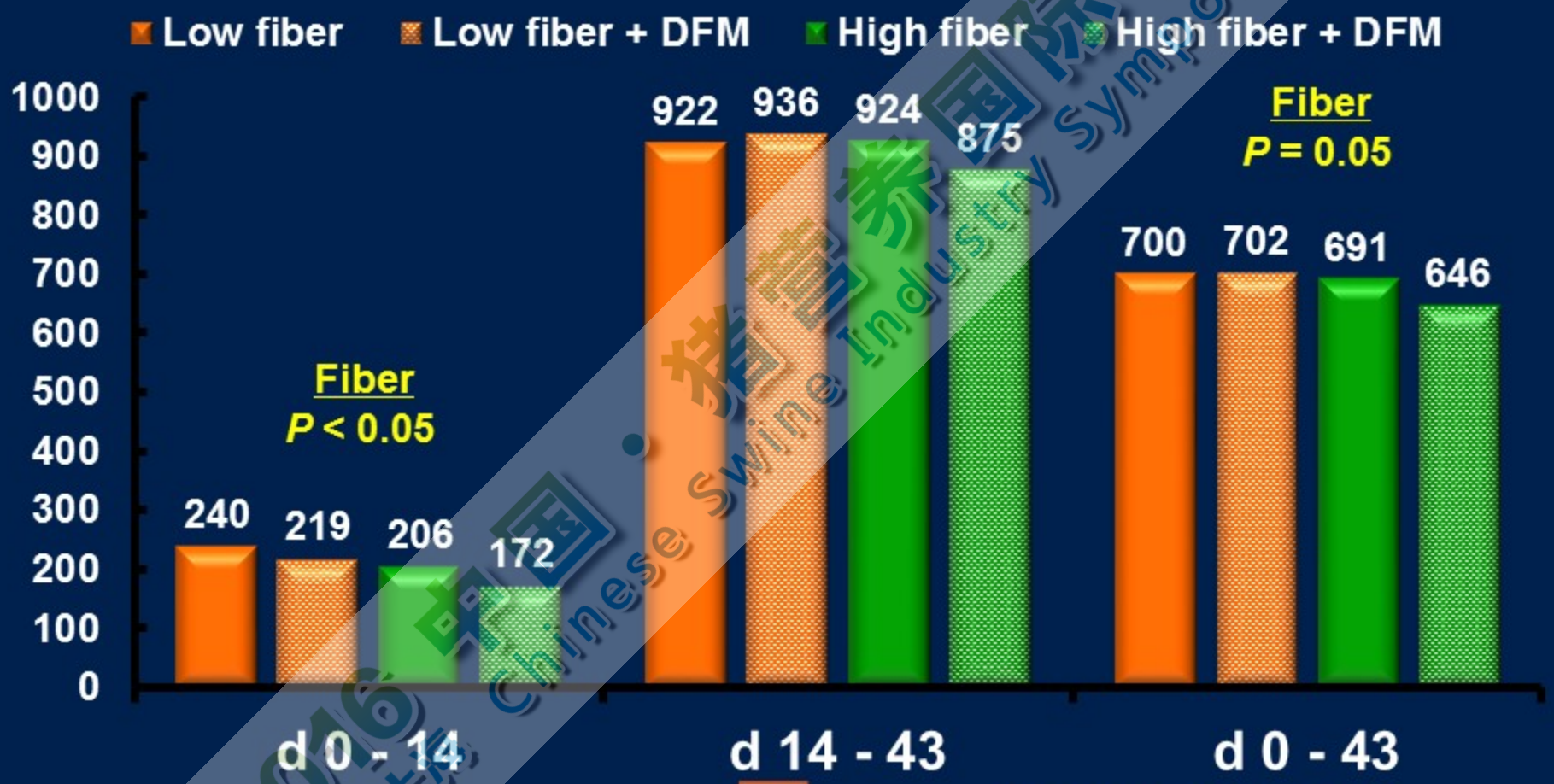
Jaworski et al., 2016

Body Weight, kg



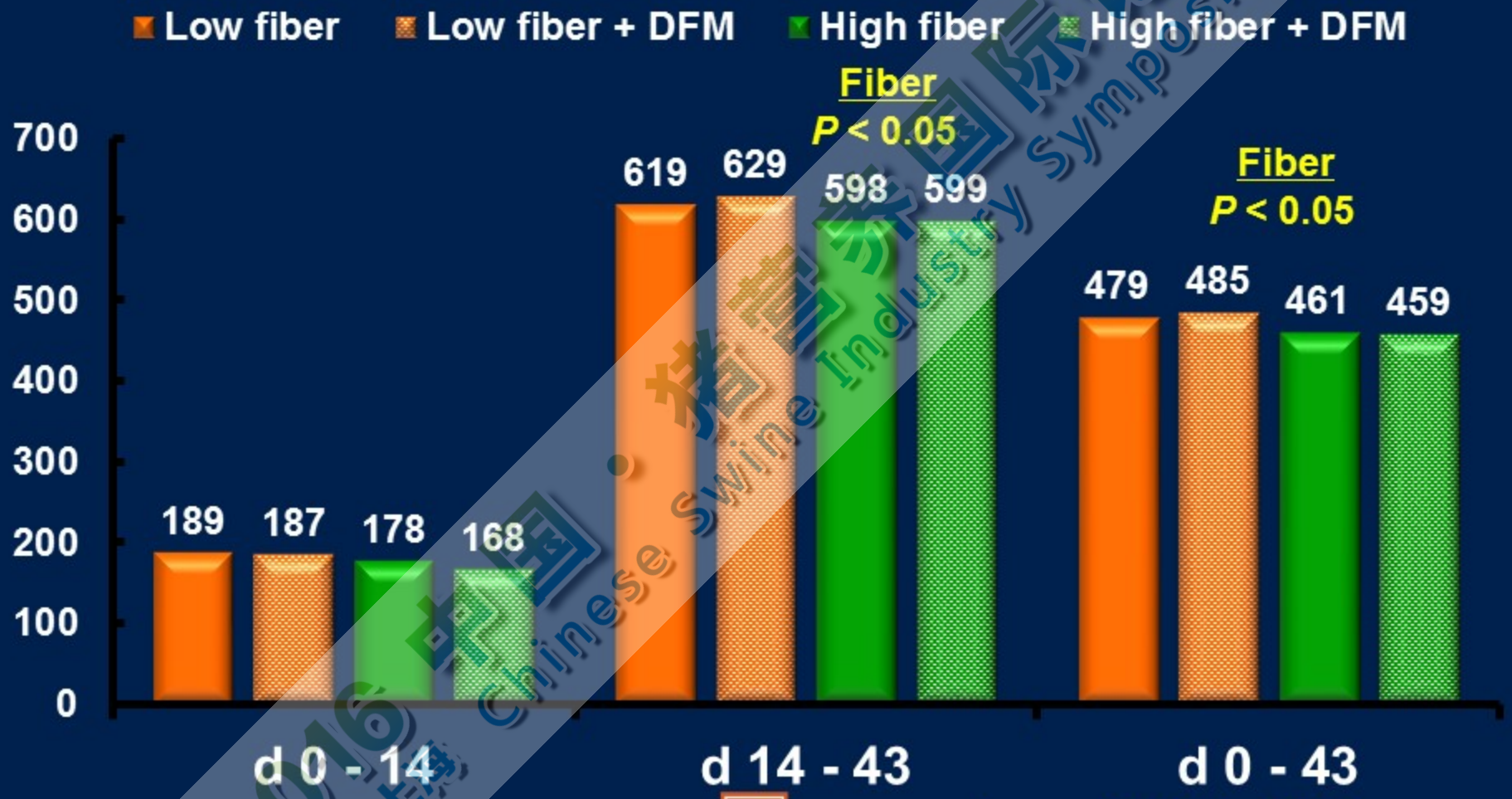
Jaworski et al., 2016

Average Daily Feed Intake, g/d



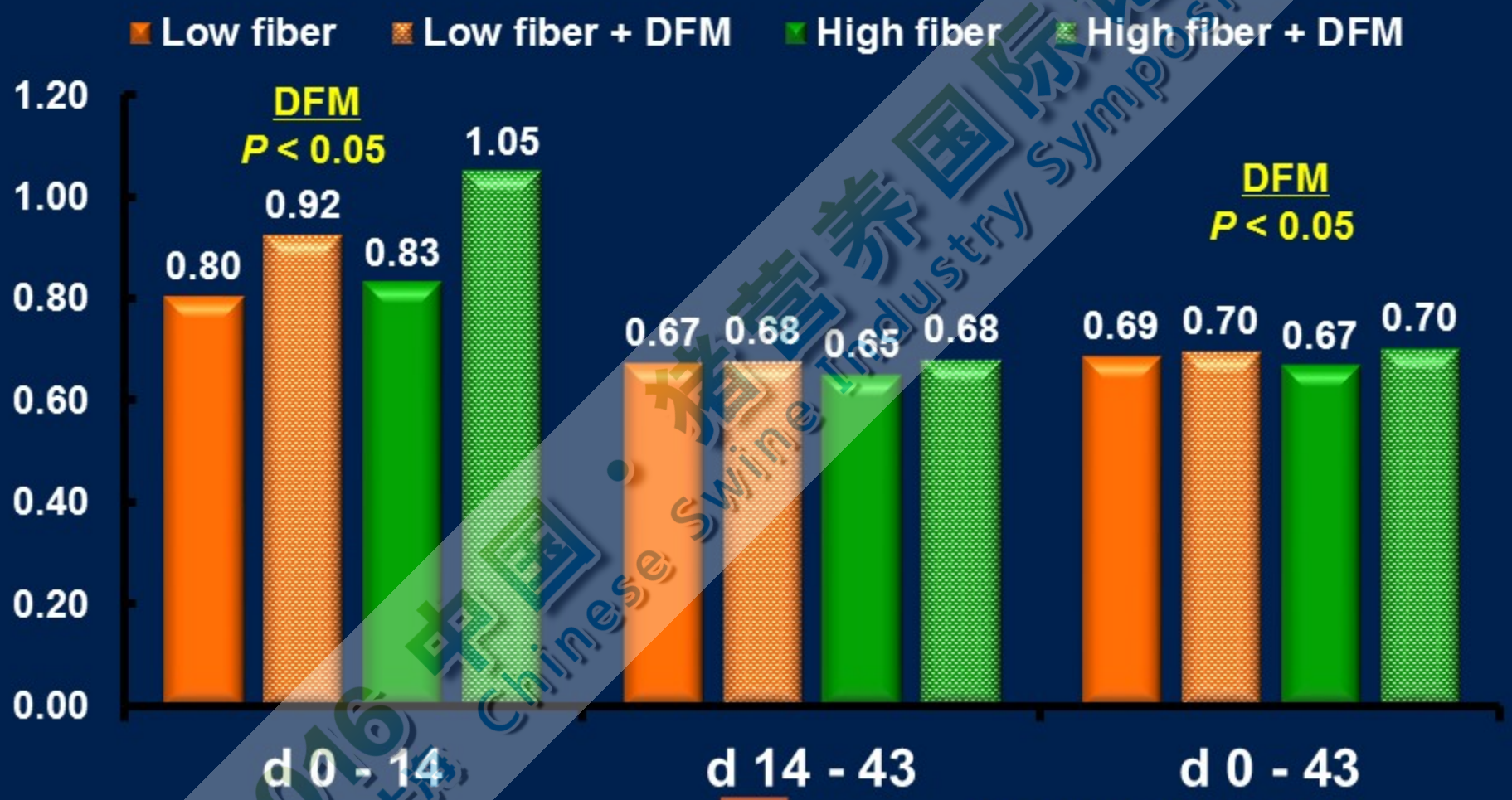
Jaworski et al., 2016

Average Daily Gain, g/d



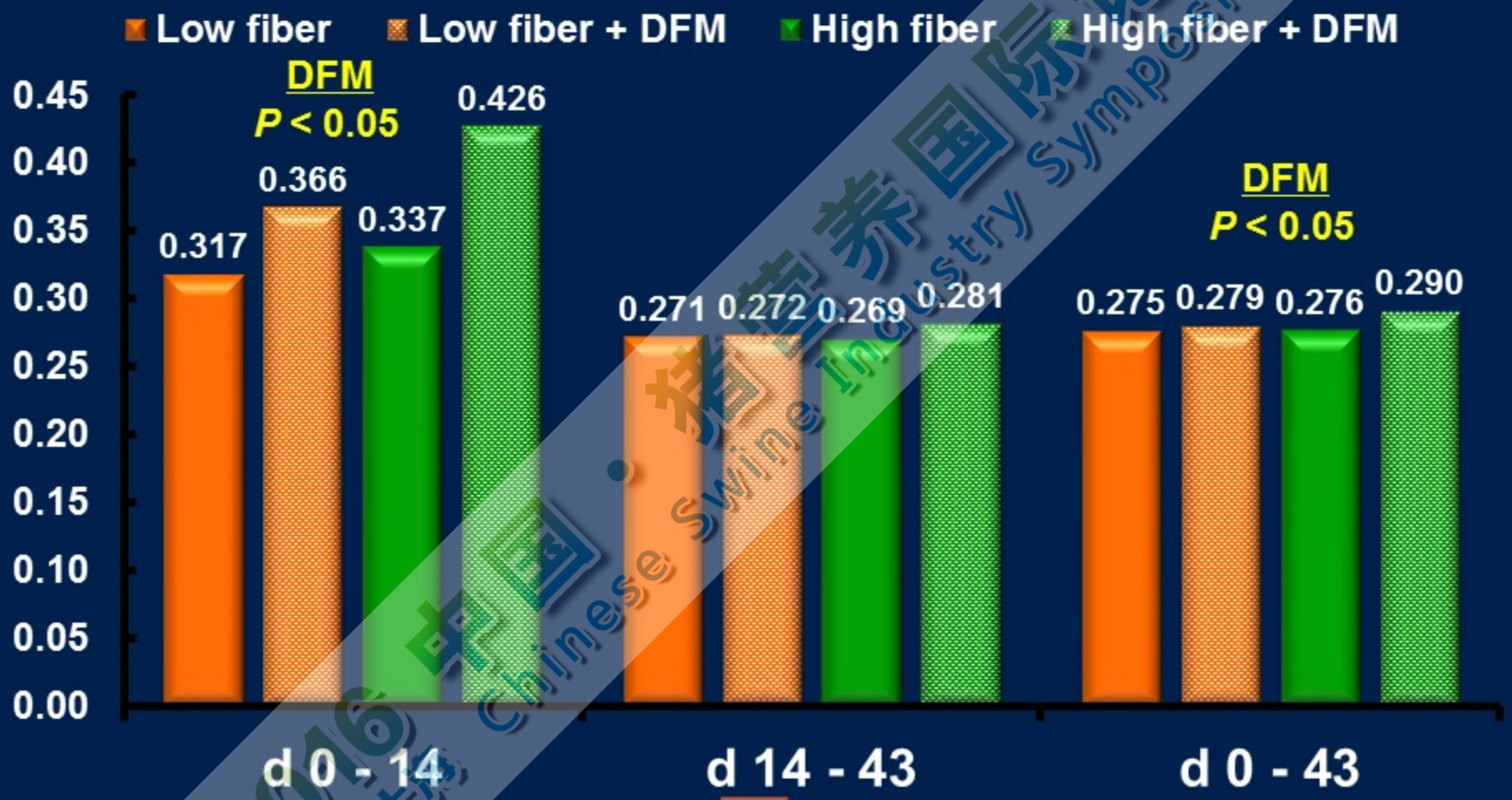
Jaworski et al., 2016

Gain:Feed, g/g



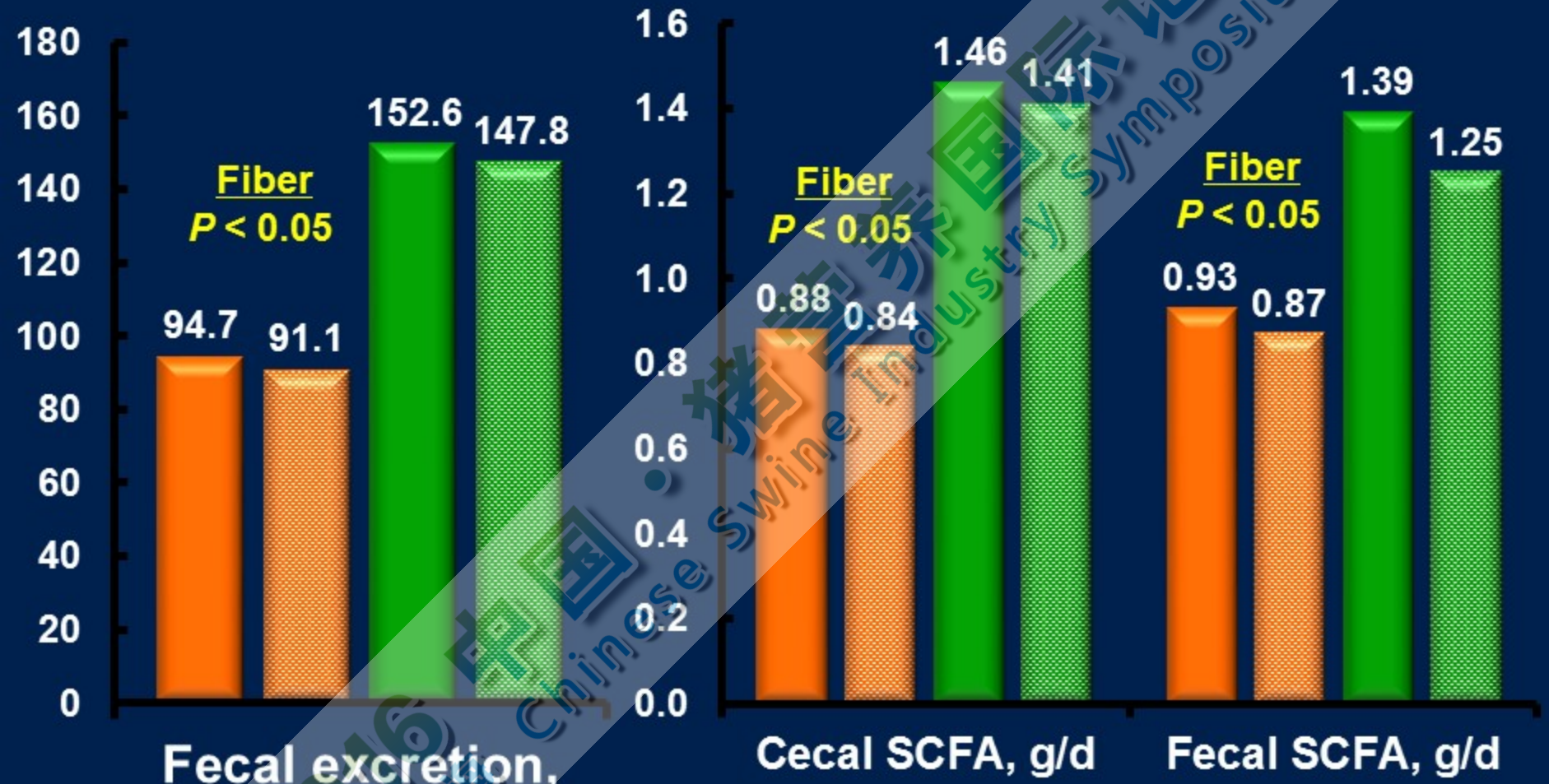
Jaworski et al., 2016

Gain:Feed, kg/Mcal NE



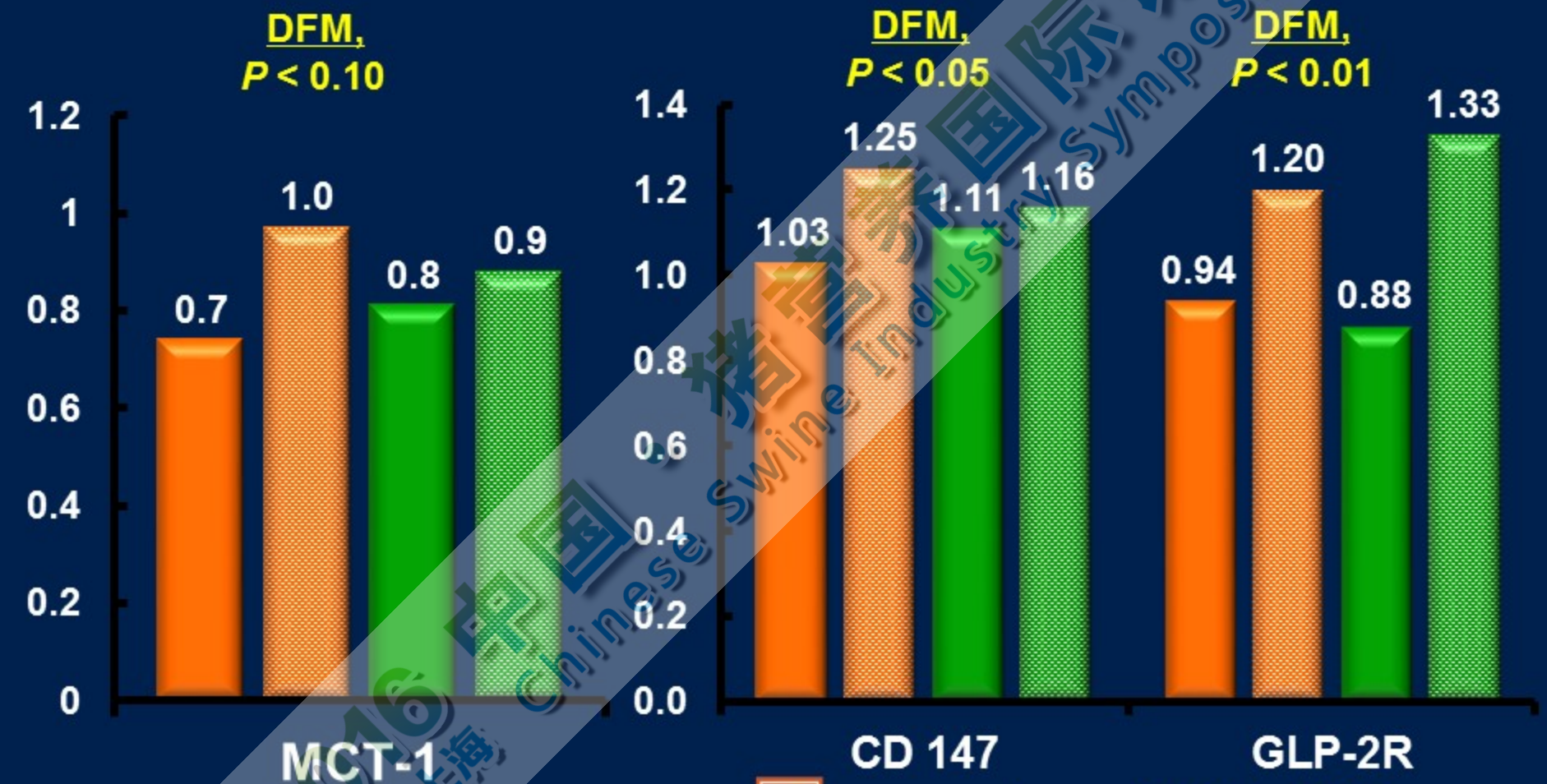
Jaworski et al., 2016

SCFA, g/d DMB



Jaworski et al., 2016

Liver Gene Expression



Jaworski et al., 2016

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Nucleotides

1867

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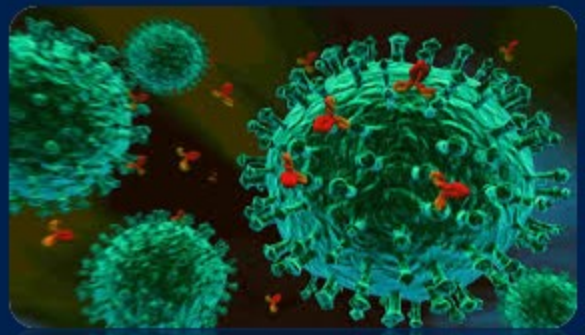
Mode of action

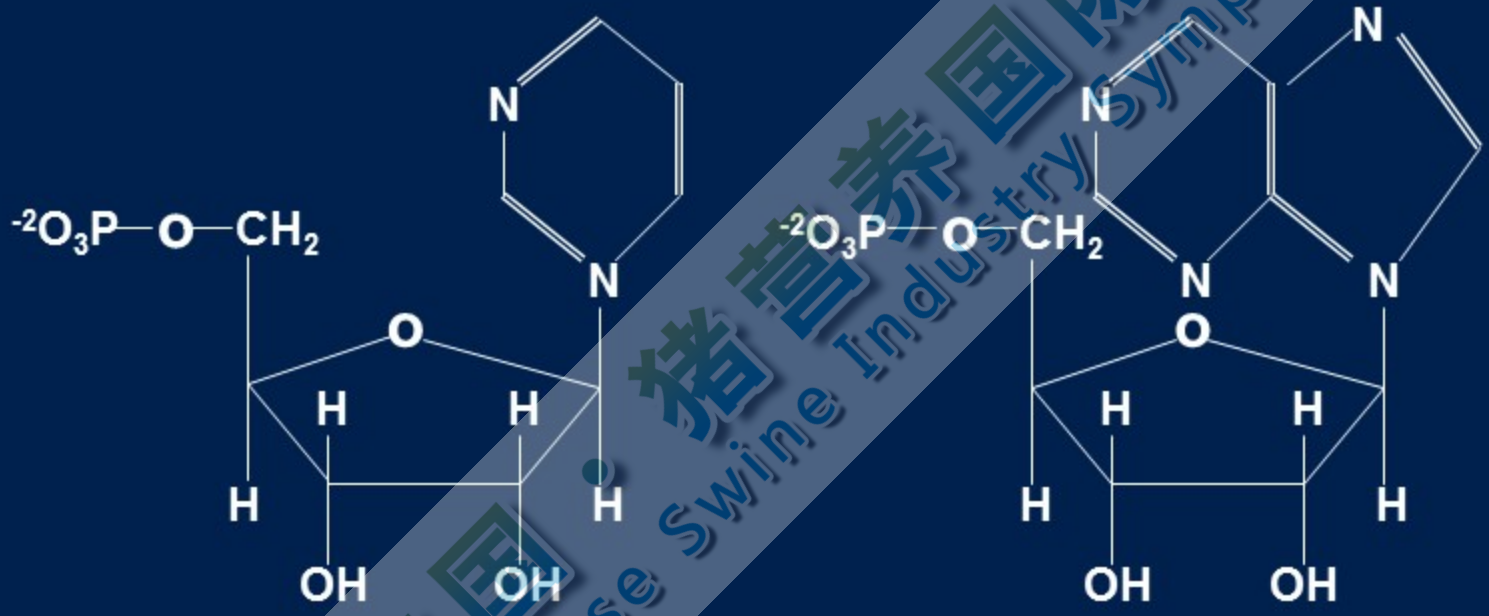


✓Immune system

✓Intestinal health

✓Microbiota

Nucleotide Structure



Pyrimidine

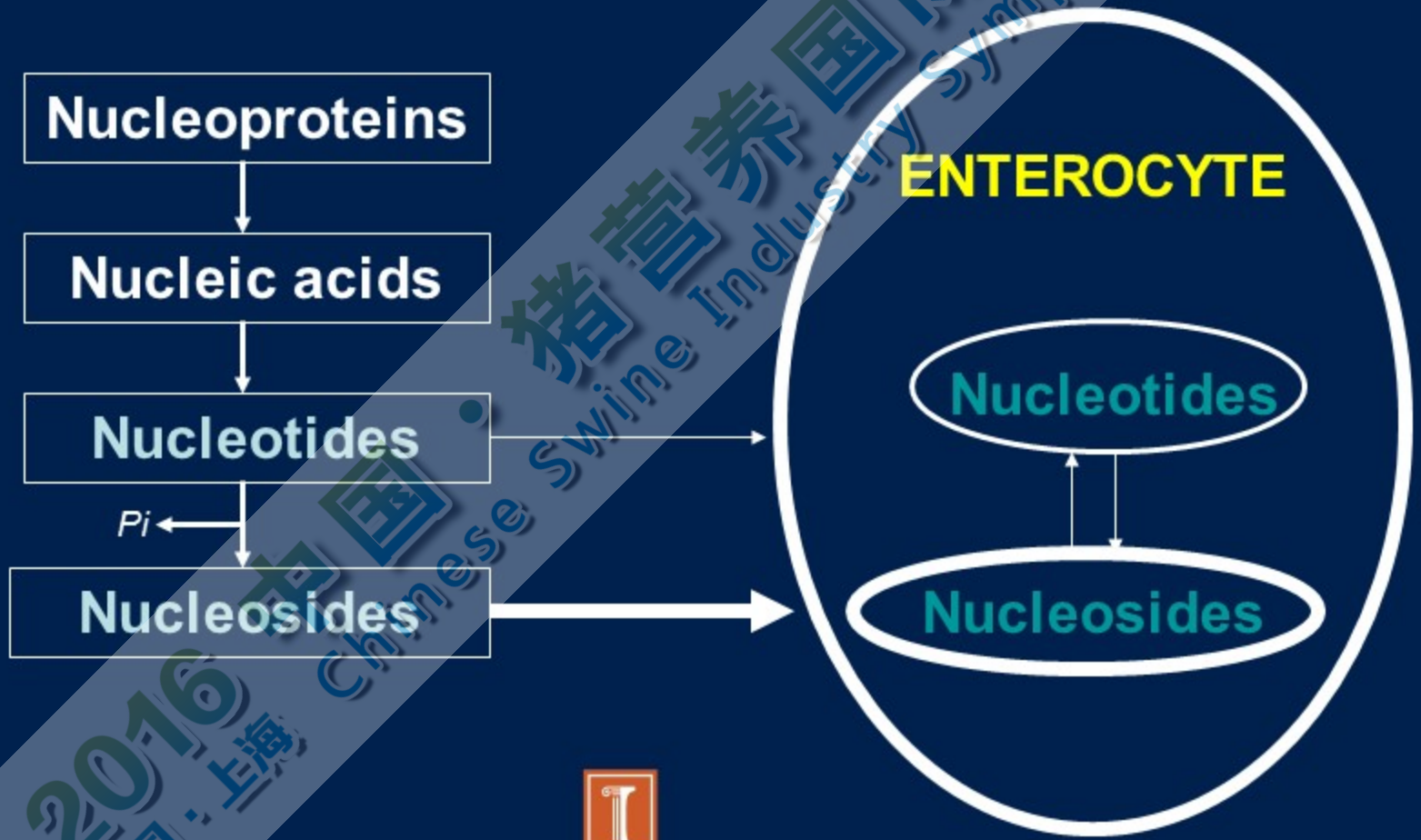
Purine

Nucleotide vs. Nucleoside

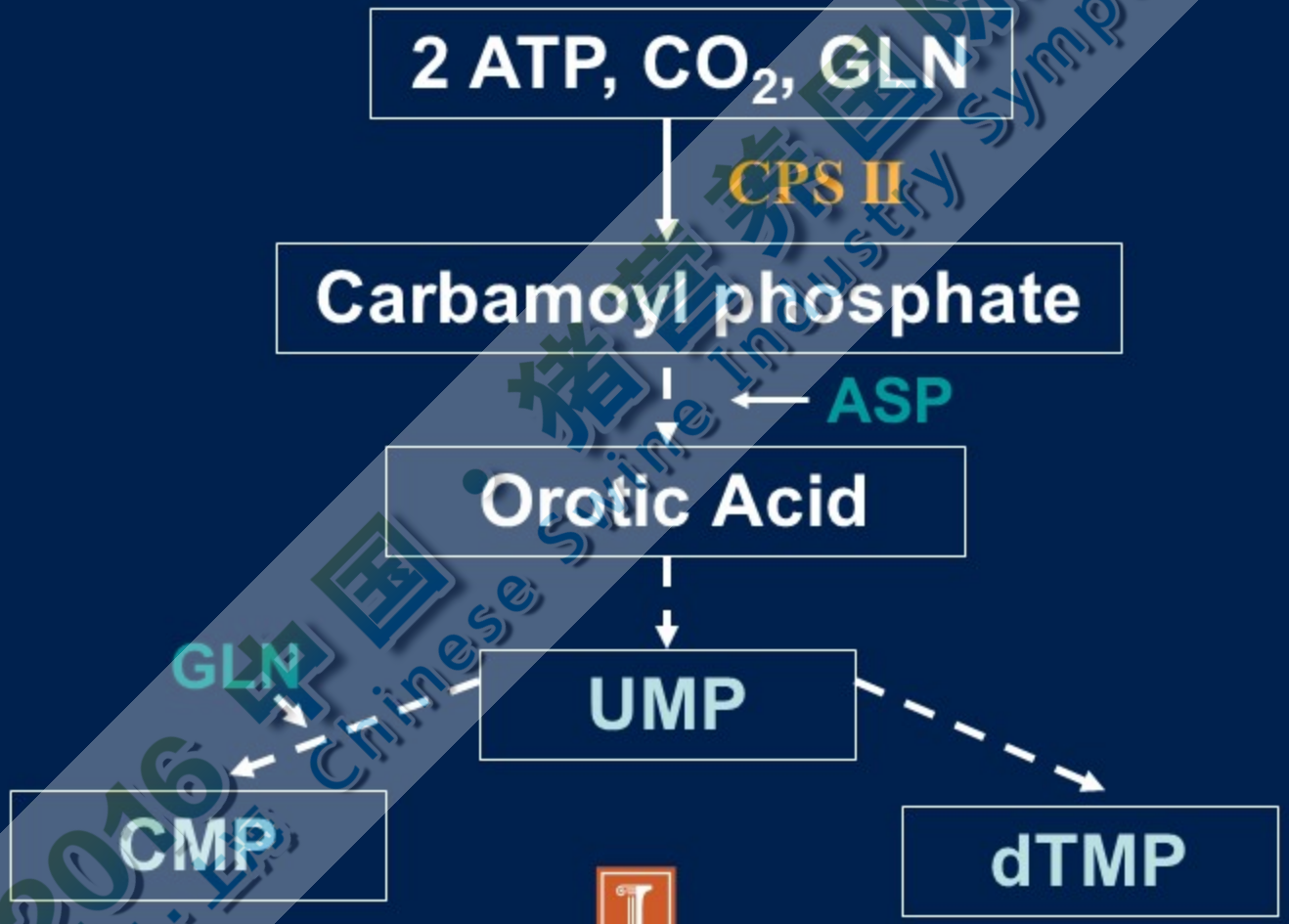
NUCLEOTIDE

NUCLEOSIDE

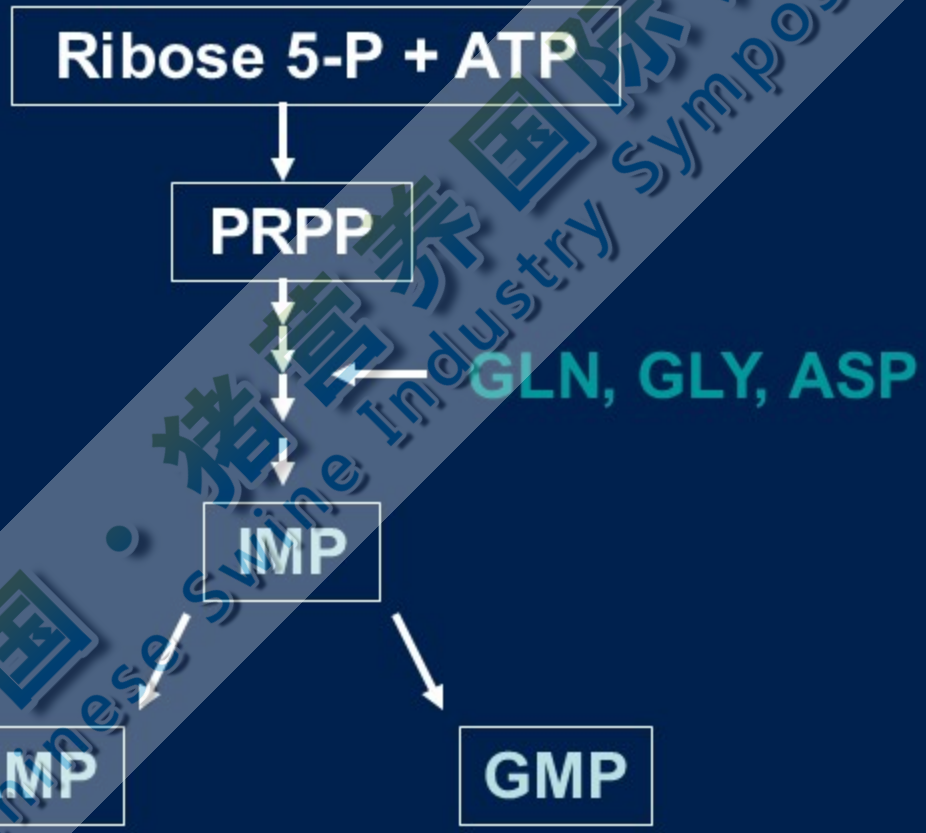
Digestion and Absorption



Pyrimidine Synthesis



Purine Synthesis



Tissue that cannot synthesize Nucleotides

2 Erythrocytes

4 Intestinal Mucosal Cells

1 Brain Cells

3 Bone marrow Cells

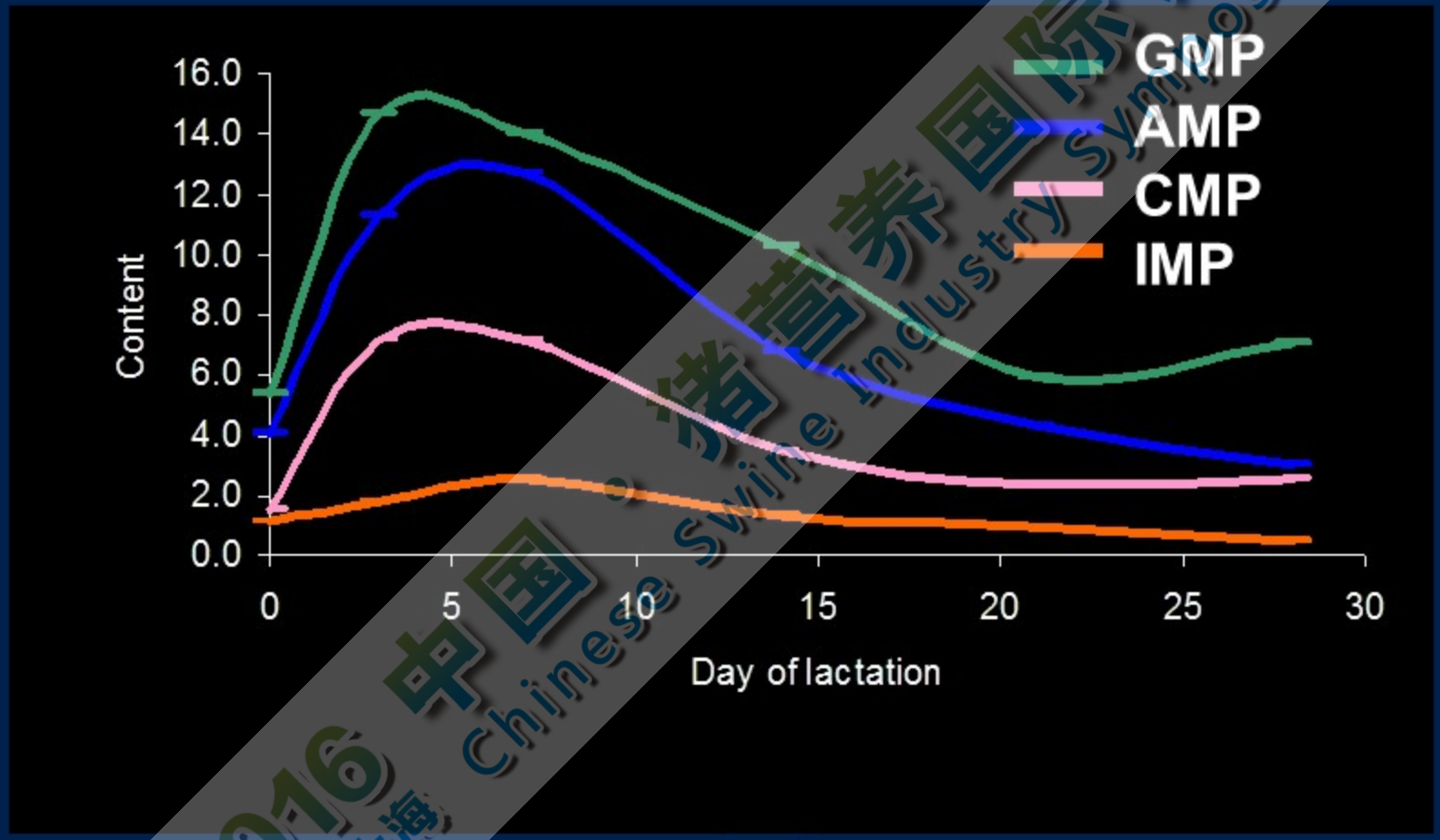
Immune compromised animals

During periods of stress

Rapidly dividing cells

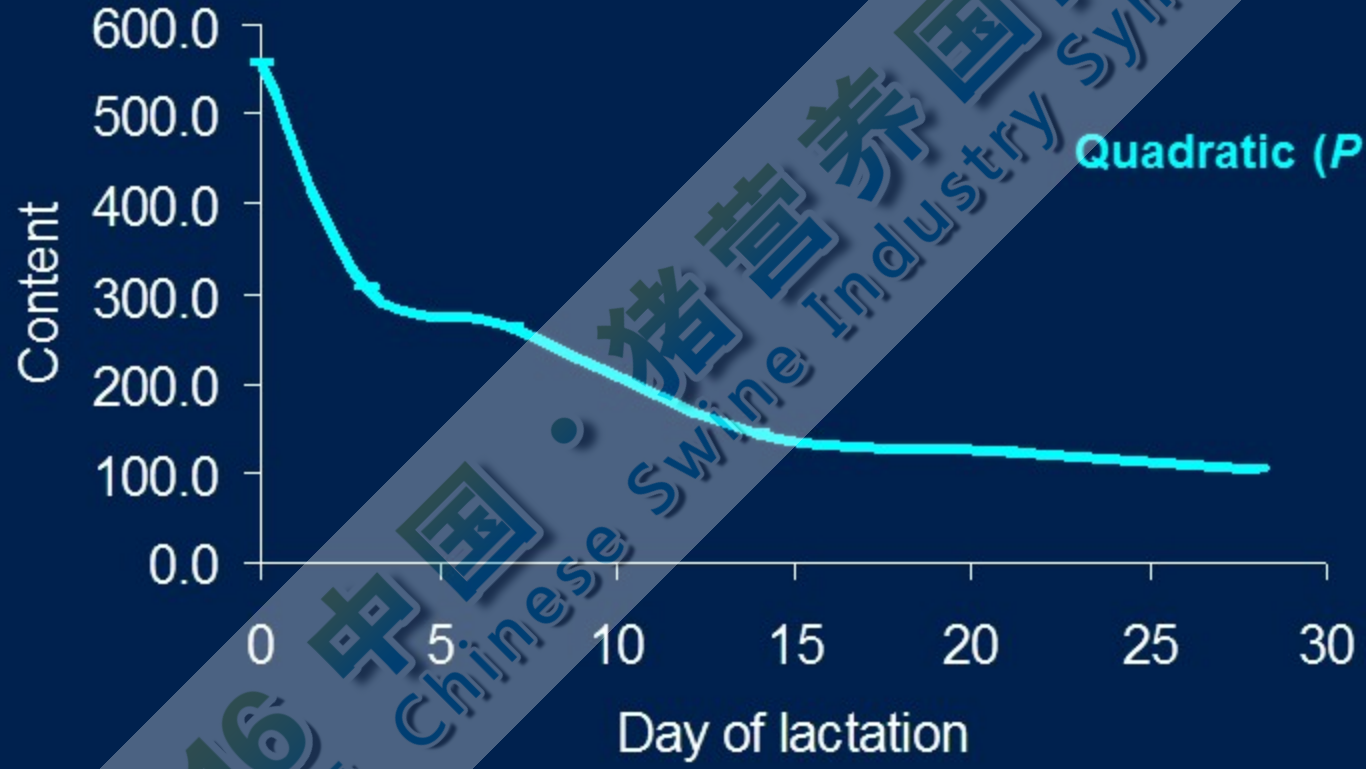
If energy intake is low

Nucleotides in Porcine Milk



Mateo et al., 2005a

5' UMP in Porcine Milk



Mateo et al., 2005a

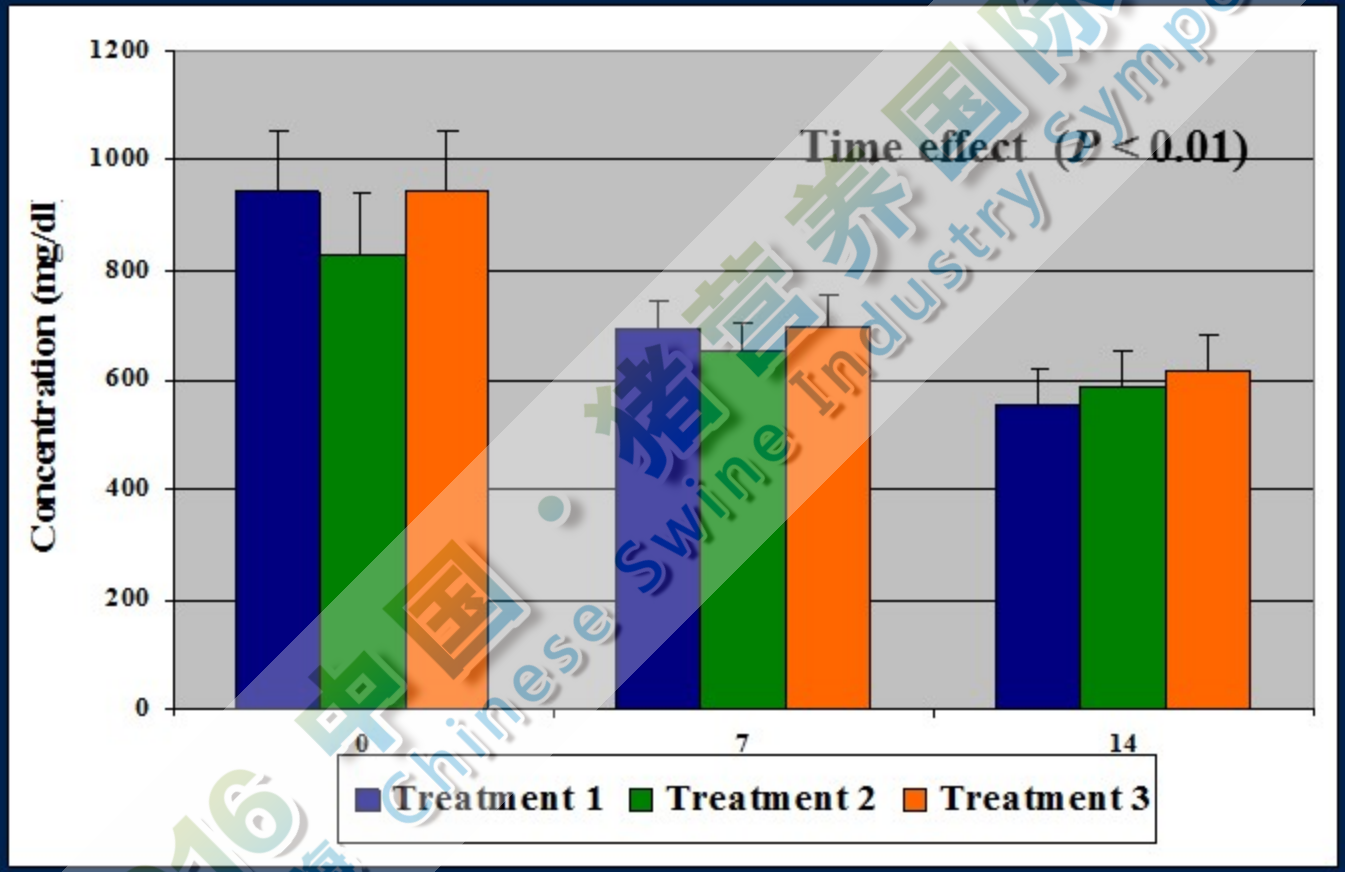
Nucleotides in Starter Diets and Milk (ppm, DM-basis)

Item	AMP	CMP	GMP	IMP	UMP
Sow Milk	118	56	186	24	2,335
Starter diet	6.5	58.9	2.03	4.33	1.00

Stein and Mateo, 2005

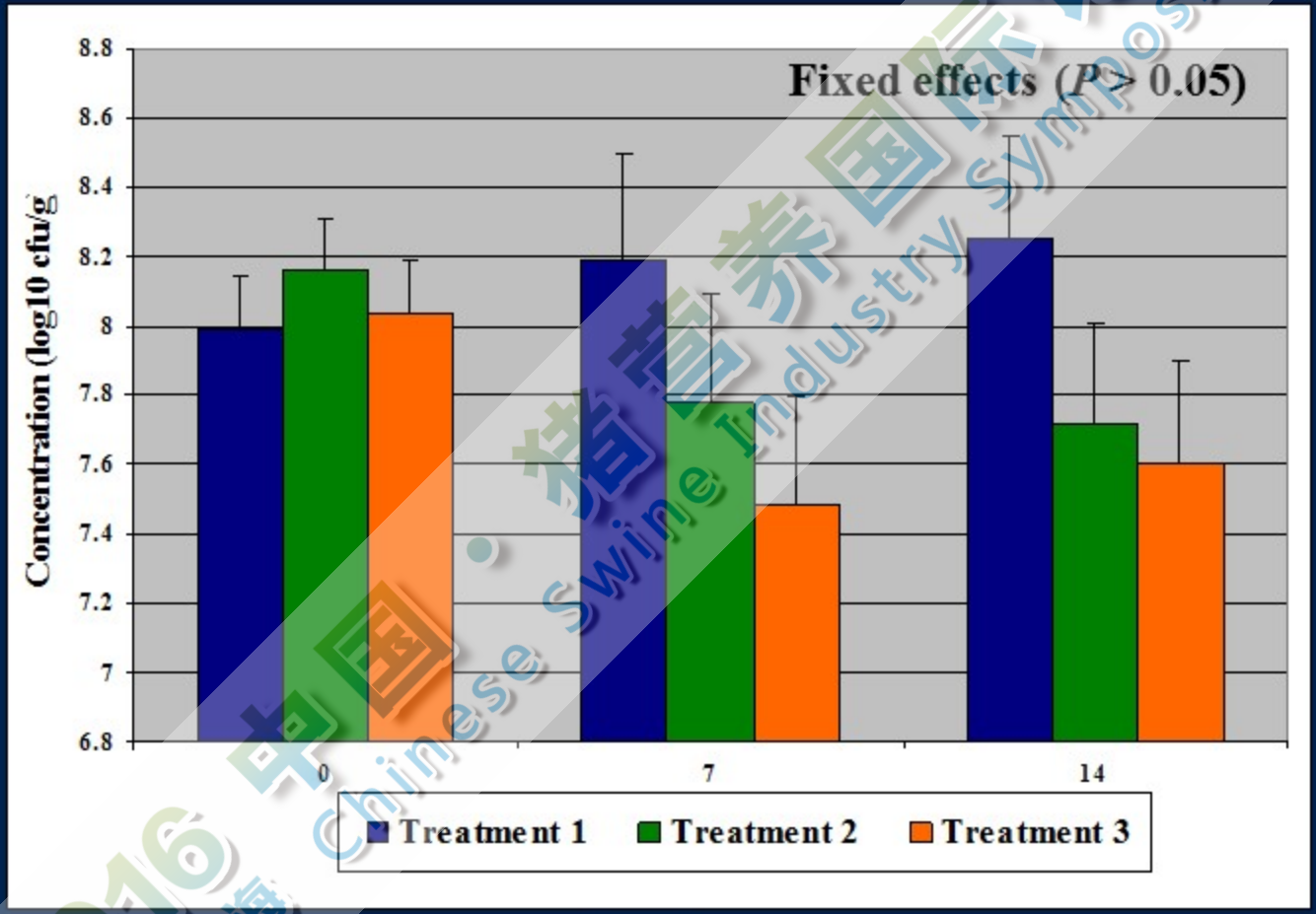
Nucleotides for pigs

Serum IgG



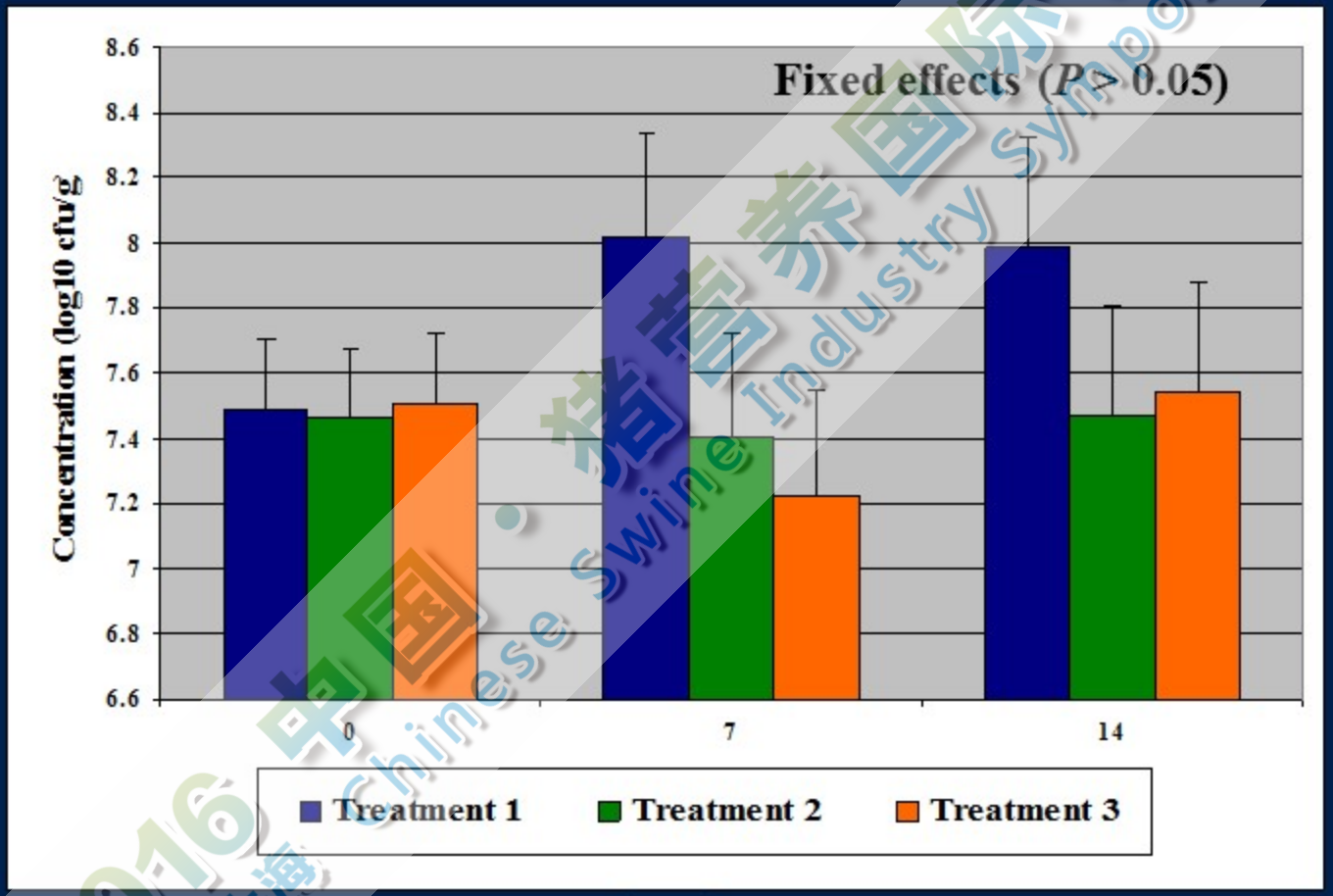
Mateo et al., 2005b

Total Coliforms



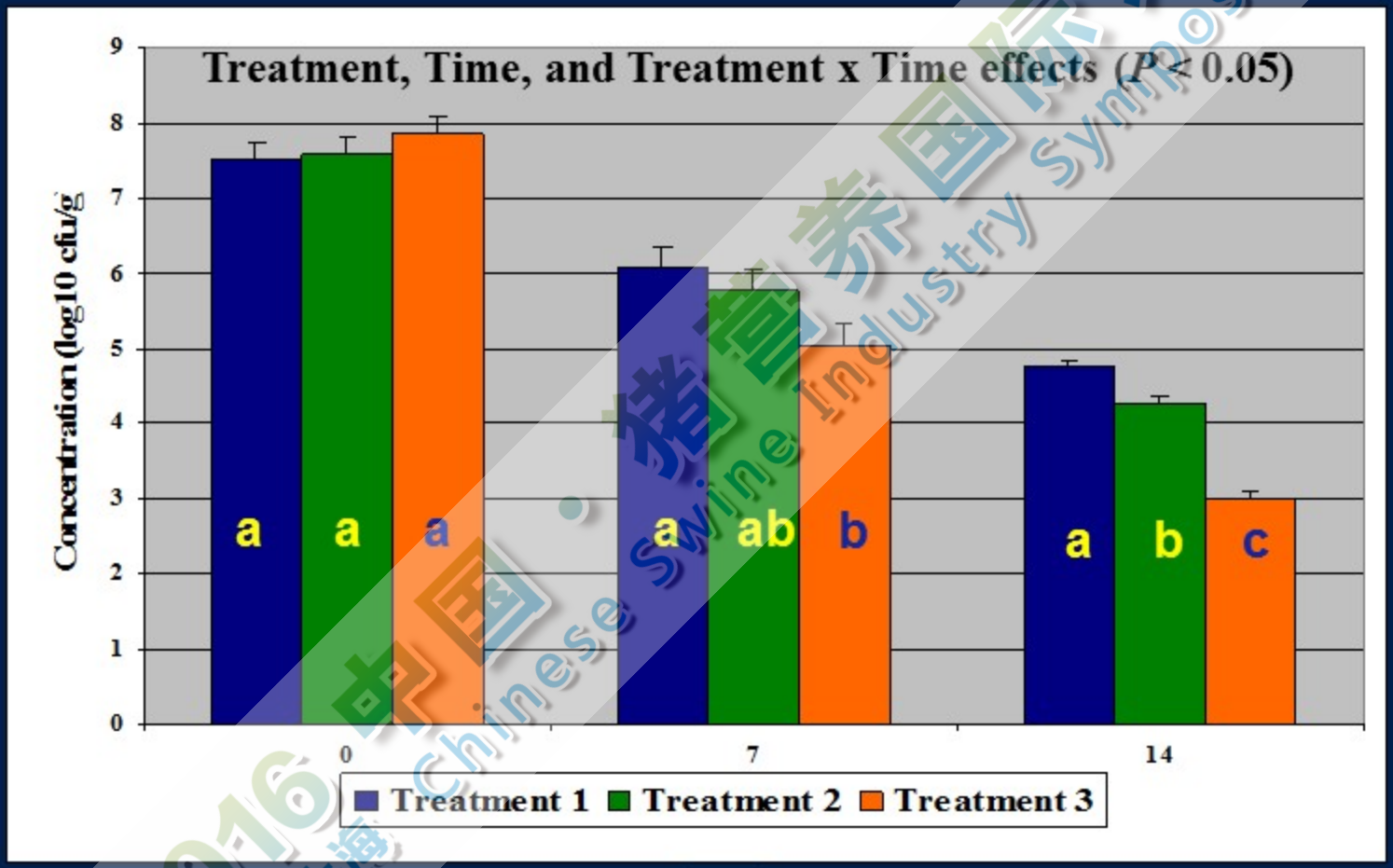
Mateo et al., 2005

E. coli



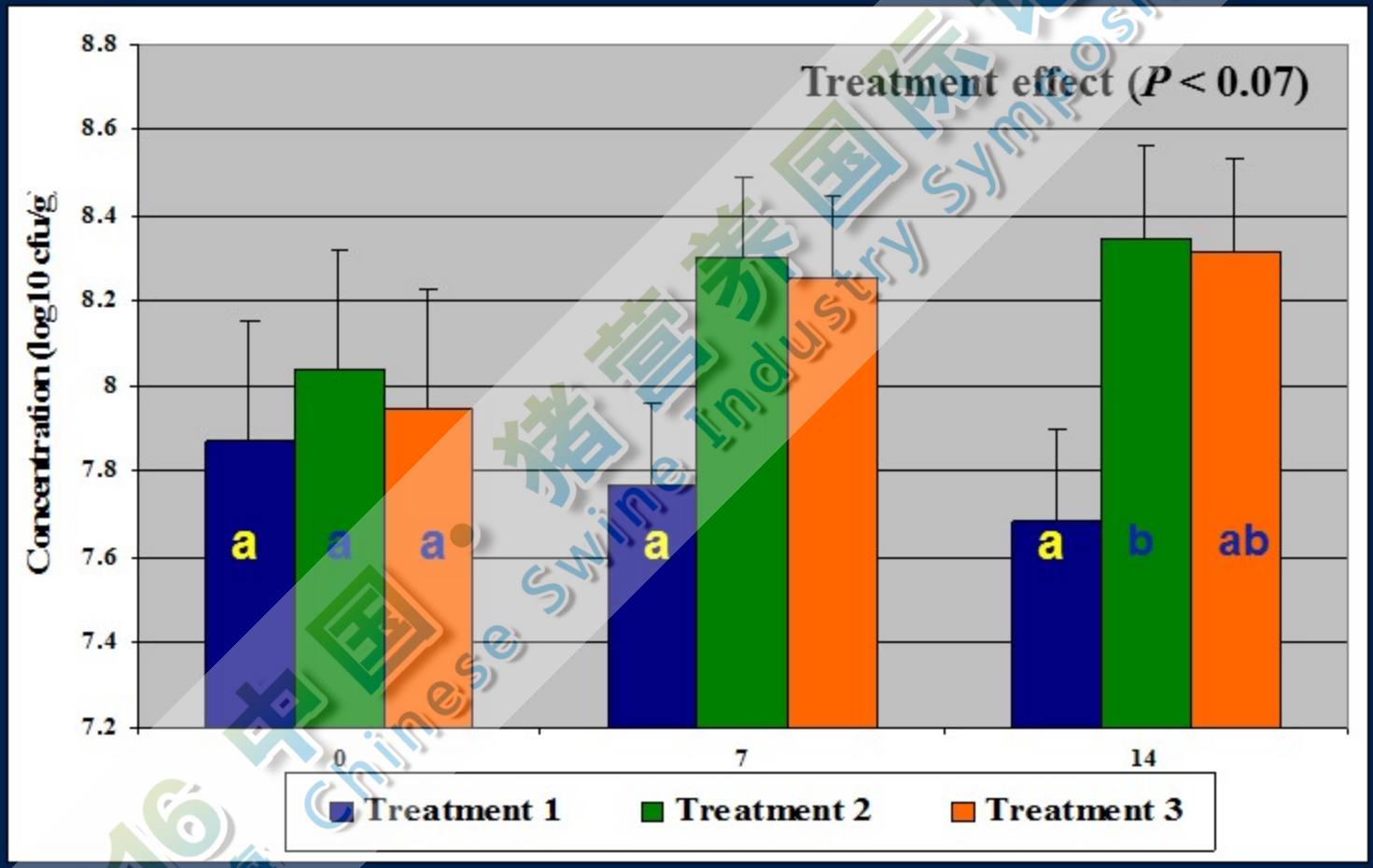
Mateo et al., 2005b

Cl. perfringens



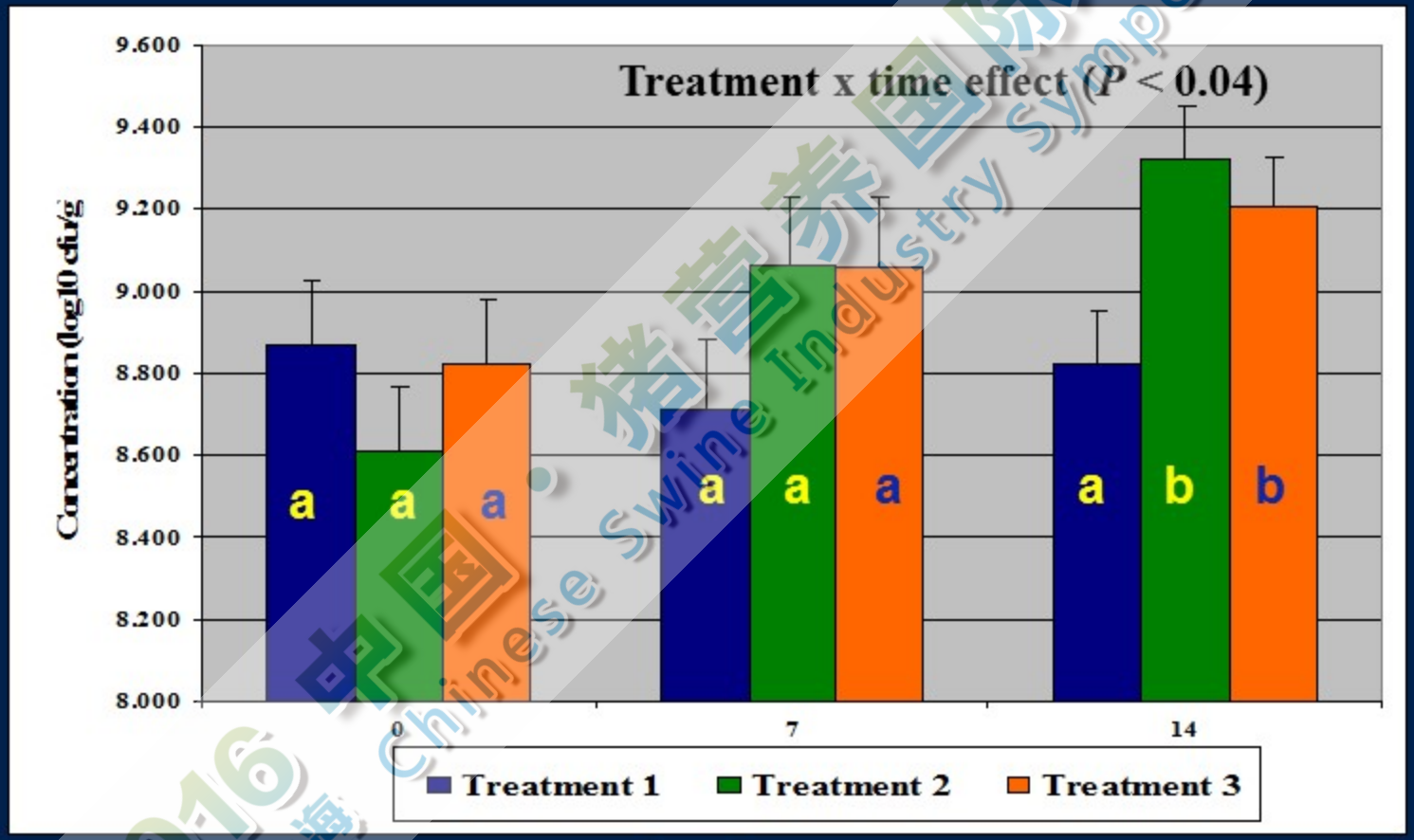
Mateo et al., 2005b

Bifidobacterium spp.



Mateo et al., 2005b

L. acidophilus



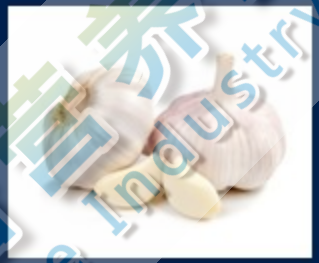
Mateo et al., 2005b

Conclusions on Nucleotides

- Young pigs may have nucleotide deficiency
- Possible modulation of microbiota
- Challenge supplying and analyzing nucleotides

→ Need for more research

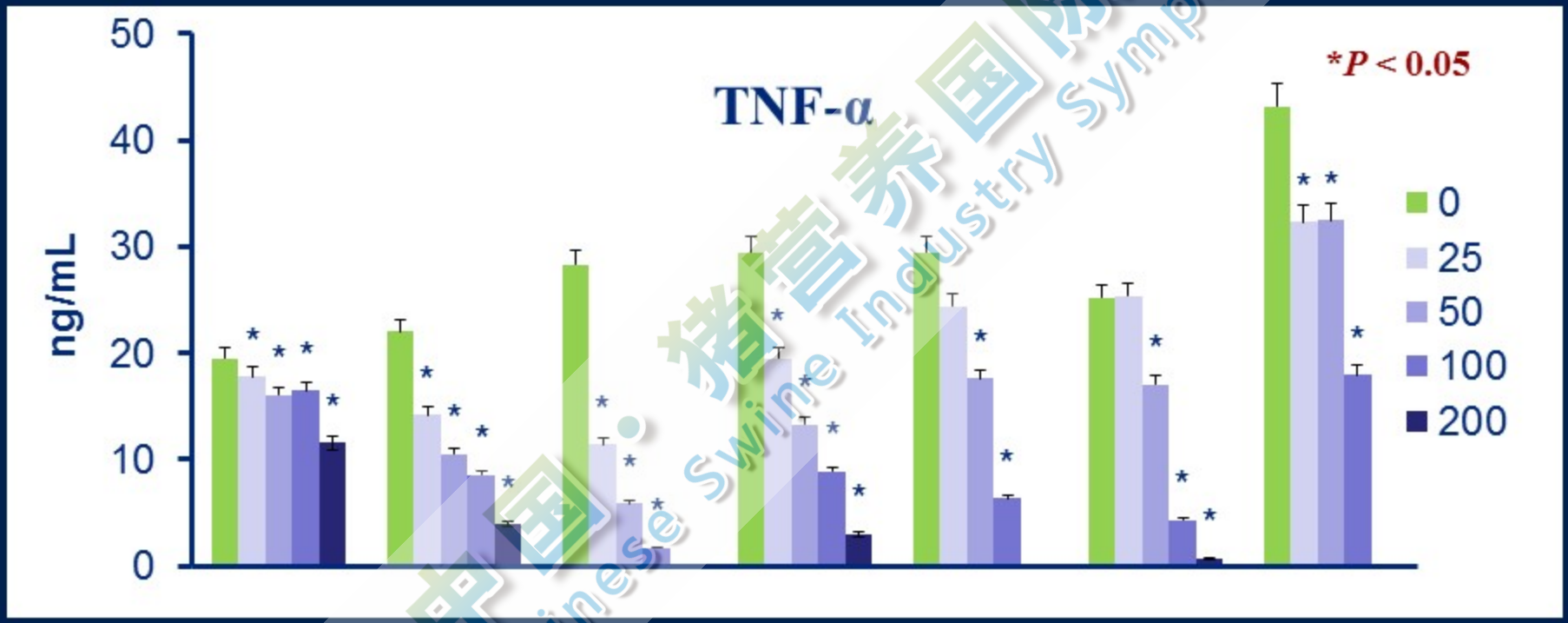
Plant Extracts



Plant Extracts

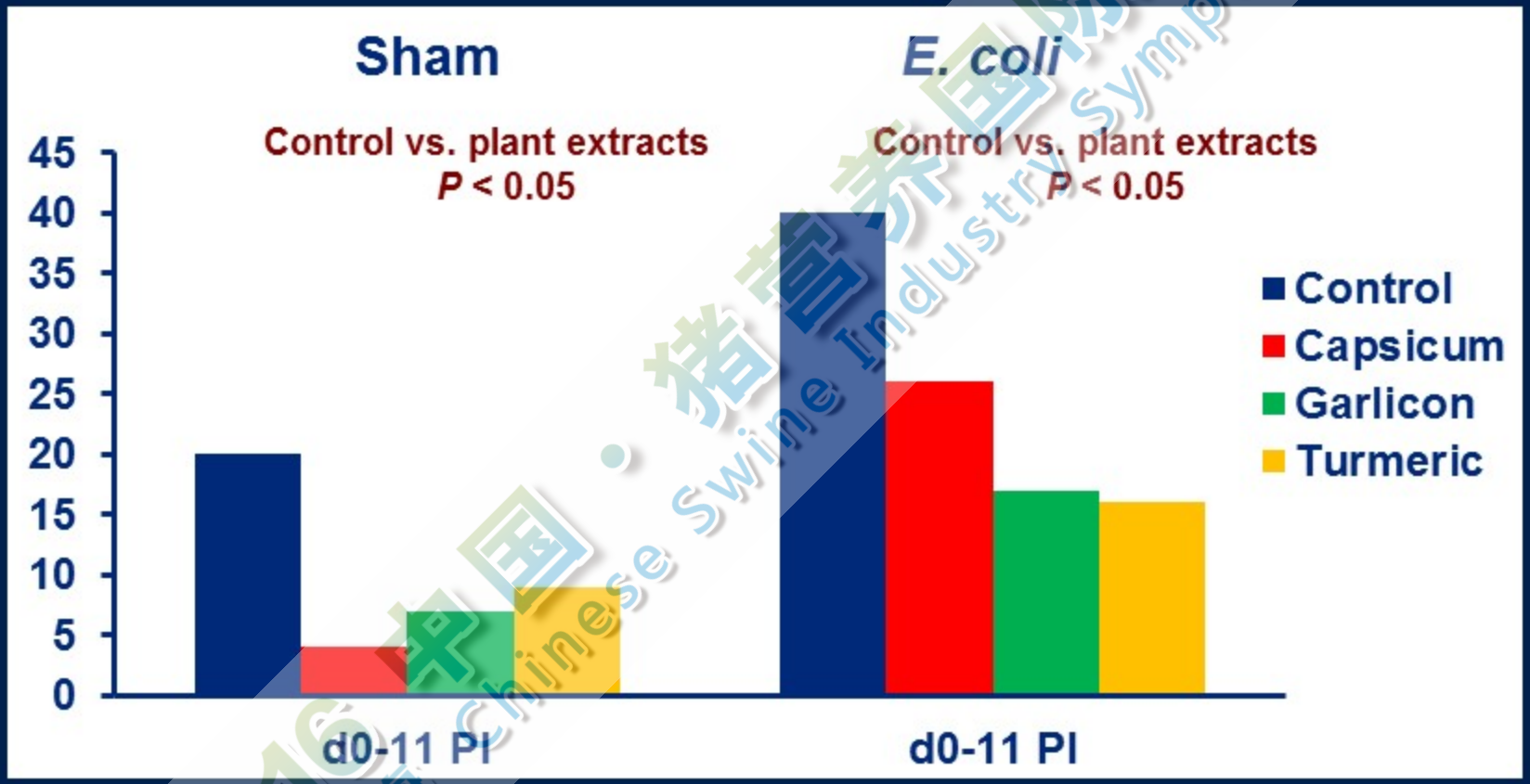
1. Concentrated, hydrophobic, volatile aroma
2. Mixtures of secondary plant metabolites
3. Antimicrobial and Anti-inflammatory
4. Antiviral, Antifungal, Antiparasitic, Antitoxigenic

In vitro anti-inflammatory effects



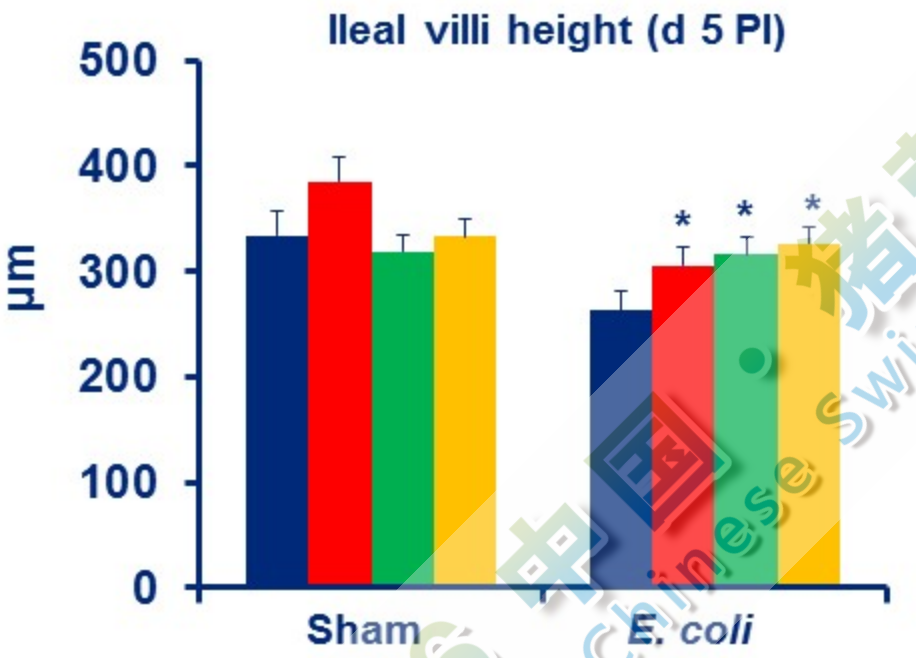
Liu et al., 2012

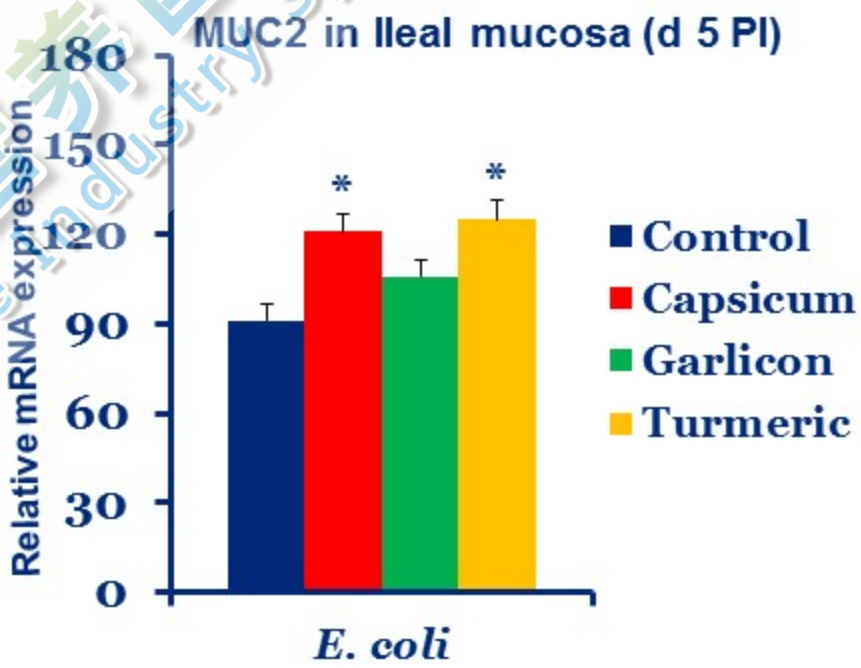
In vivo Experiment, Diarrhea frequency



Liu et al., 2013

Improved Gut Health



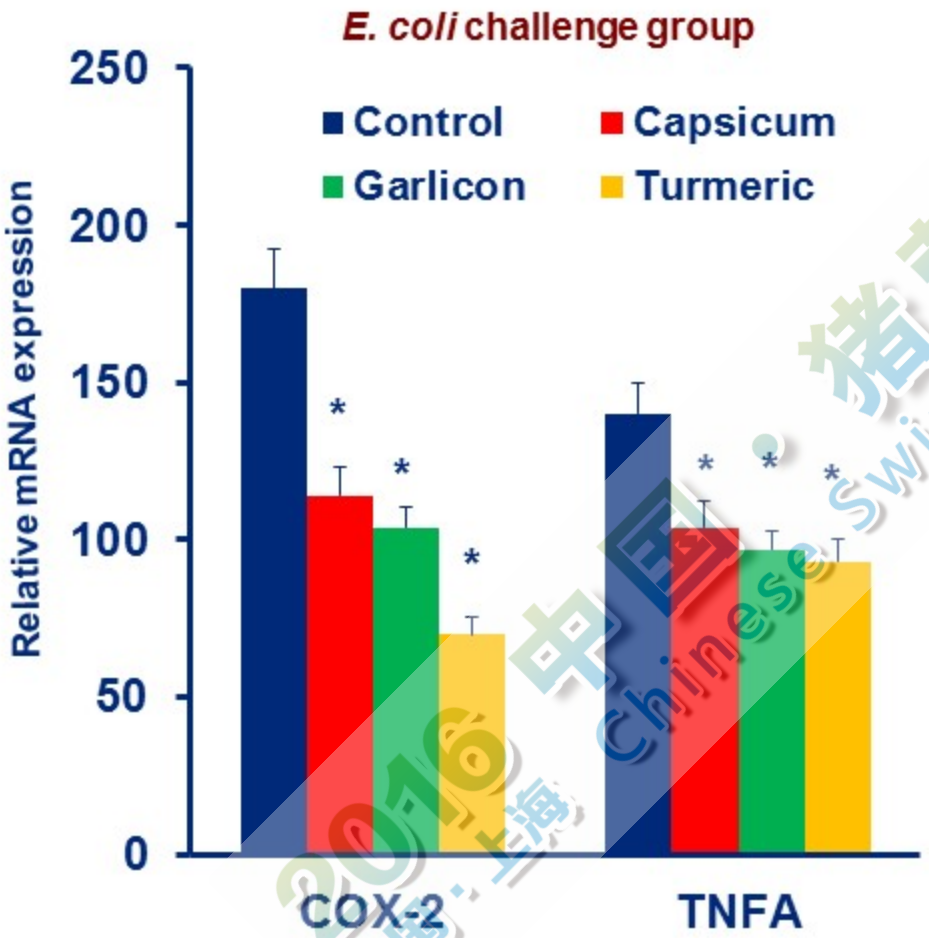


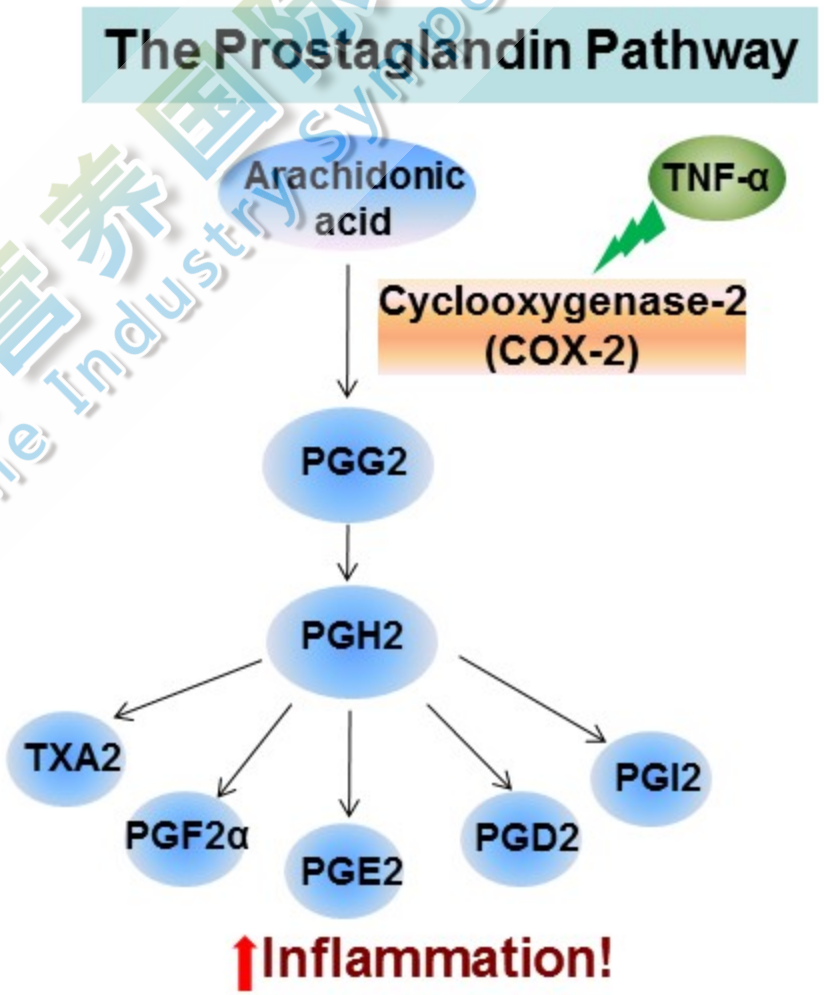
➢ Possibly improved gut barrier function!

*$P < 0.05$ compared with control

Liu et al., 2013, 2014

Plant extracts reduced gut inflammation caused by *E. coli* infection





Liu et al., 2014

Plant Extracts

- Reduced diarrhea and improved intestinal barrier function
- Reduced TNF-α and white blood cells and intestinal inflamation
- Need to have results verified in commercial experiments

Healthier Pig

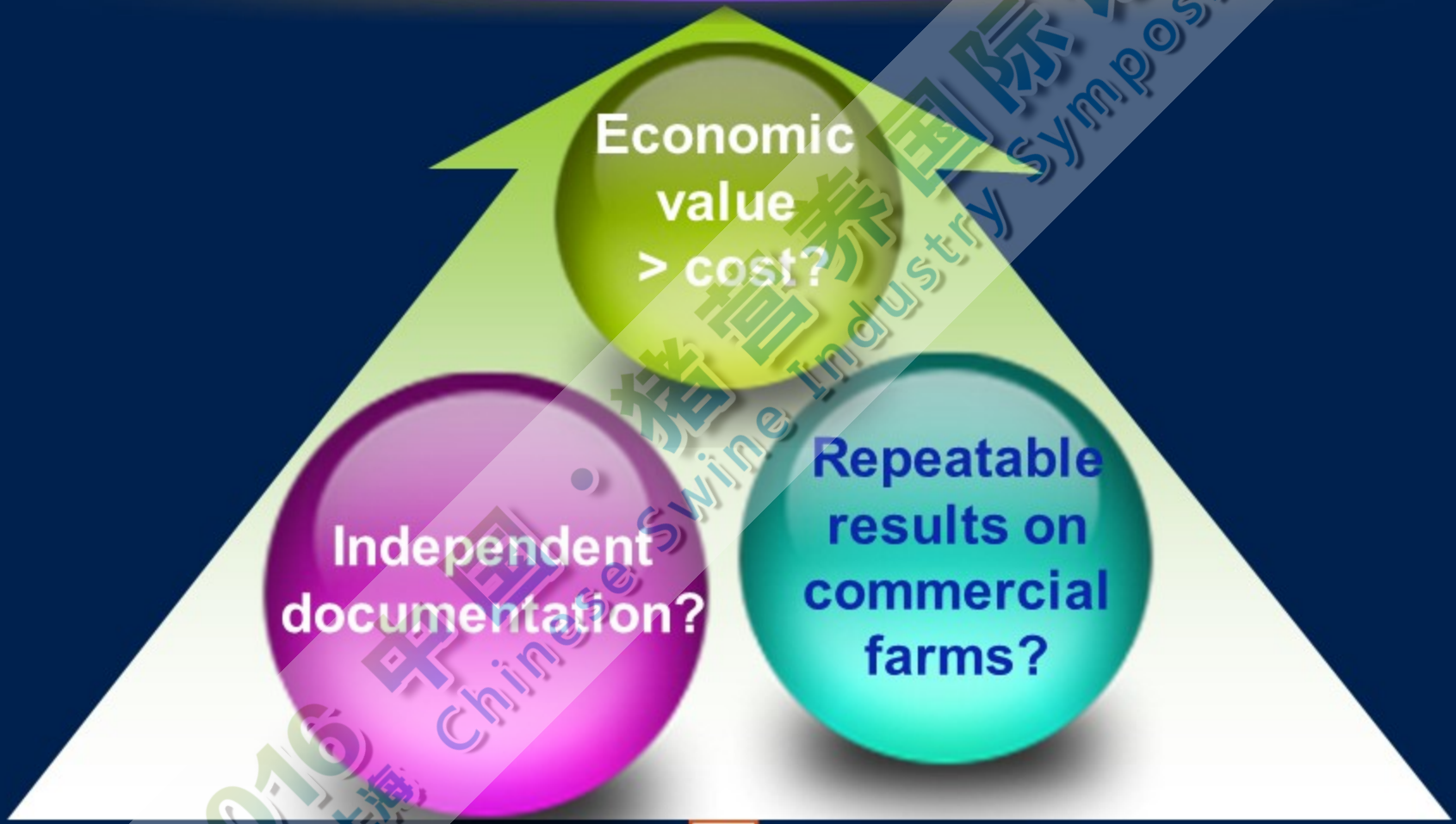
Overall Conclusions

1. Many additives available
2. Documented effects in controlled studies
3. Need testing under commercial conditions

Evaluation

1	2	3
Copper and Zinc have consistent effects	Acidifiers and plant extracts have many positive data	Prebiotics, probiotics, yeast, and nucleotides may work

Use Additive



Acknowledgement 致谢

http://nutrition.ansci.illinois.edu