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Issues related to protein fermentation in the intestines of pigs

Jérôme Bindelle

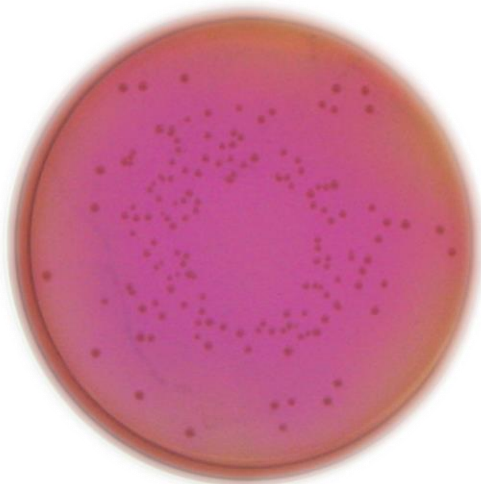
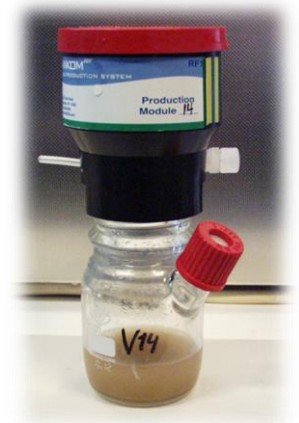
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Methods used

- In vitro digestibility and fermentation models
- In vivo growth and digestibility experiments
- Challenges (*Salmonella enterica* Typhimurium) using a Trojan model




Intestinal microbiota in pigs

- Mainly Gram +
 - strict anaerobe *Streptococcus*, *Lactobacillus*, *Peptostreptococcus*, *Clostridium*, *Eubacterium*, (*Bifidobacterium*,, *Ruminococcus*, *Escherichia*)
- Gram –
 - *Bacteroides*, (*Fusobacterium*, *Selenomonas*, *Butyrivibrio*, *Prevotella*)
- High population of lactobacilli in proximal GIT (small intestine)

When did breeders start to be (really) interested in microbiota in pigs ?

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IP/05/1687
Brussels, 22 December 2005

Ban on antibiotics as growth promoters in animal feed enters into effect

An EU-wide ban on the use of antibiotics as growth promoters in animal feed enters into effect on January 1, 2006. The last 4 antibiotics which have been permitted as feed additives to help fatten livestock will no longer be allowed to be marketed or used from this date. The ban is the final step in the phasing out of antibiotics used for non-medicinal purposes. It is part of the Commission's overall strategy to tackle the emergence of bacteria and other microbes resistant to antibiotics, due to their overexploitation or misuse.

Markos Kyprianou, Commissioner for Health and Consumer Protection, said: "This ban on

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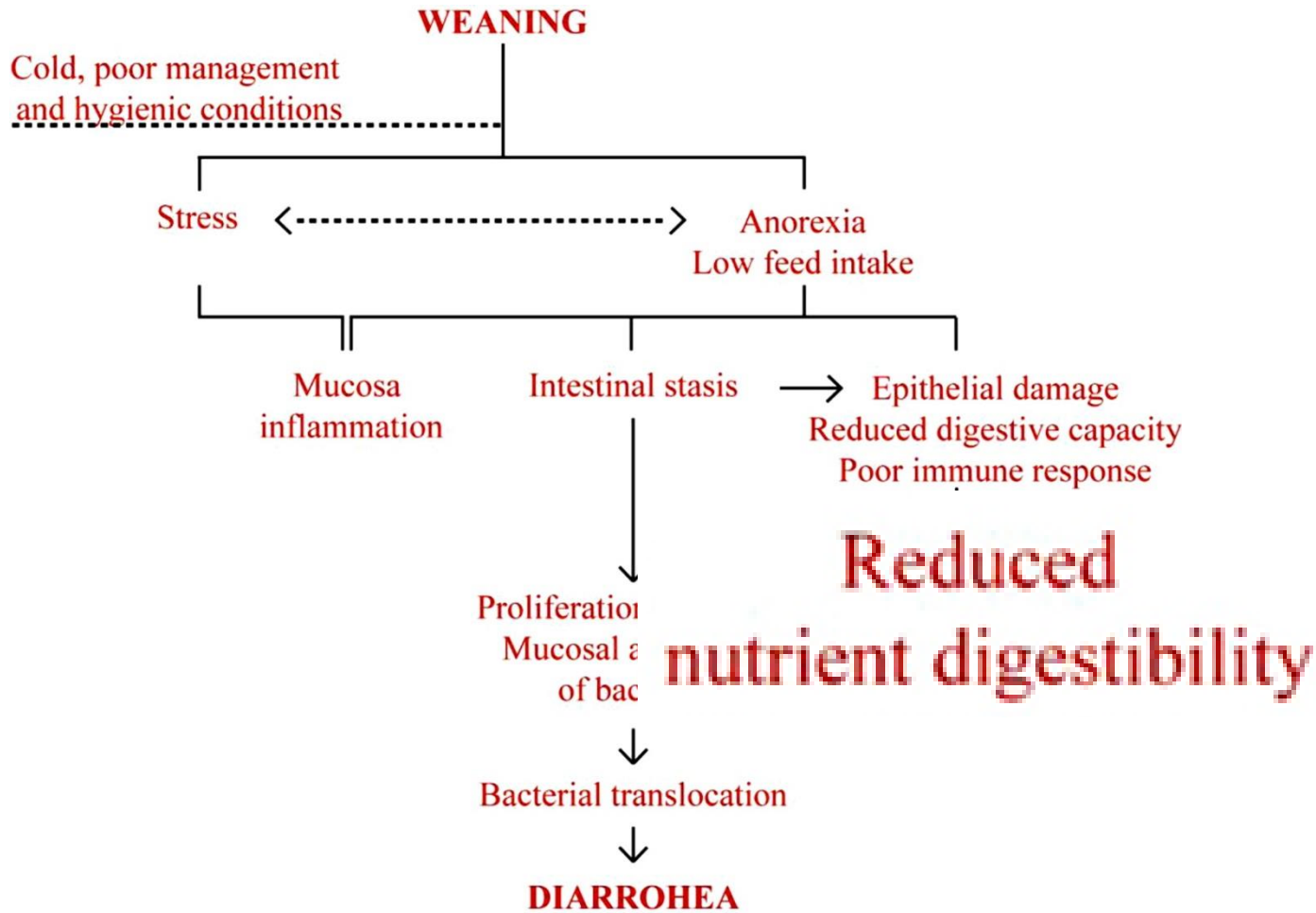
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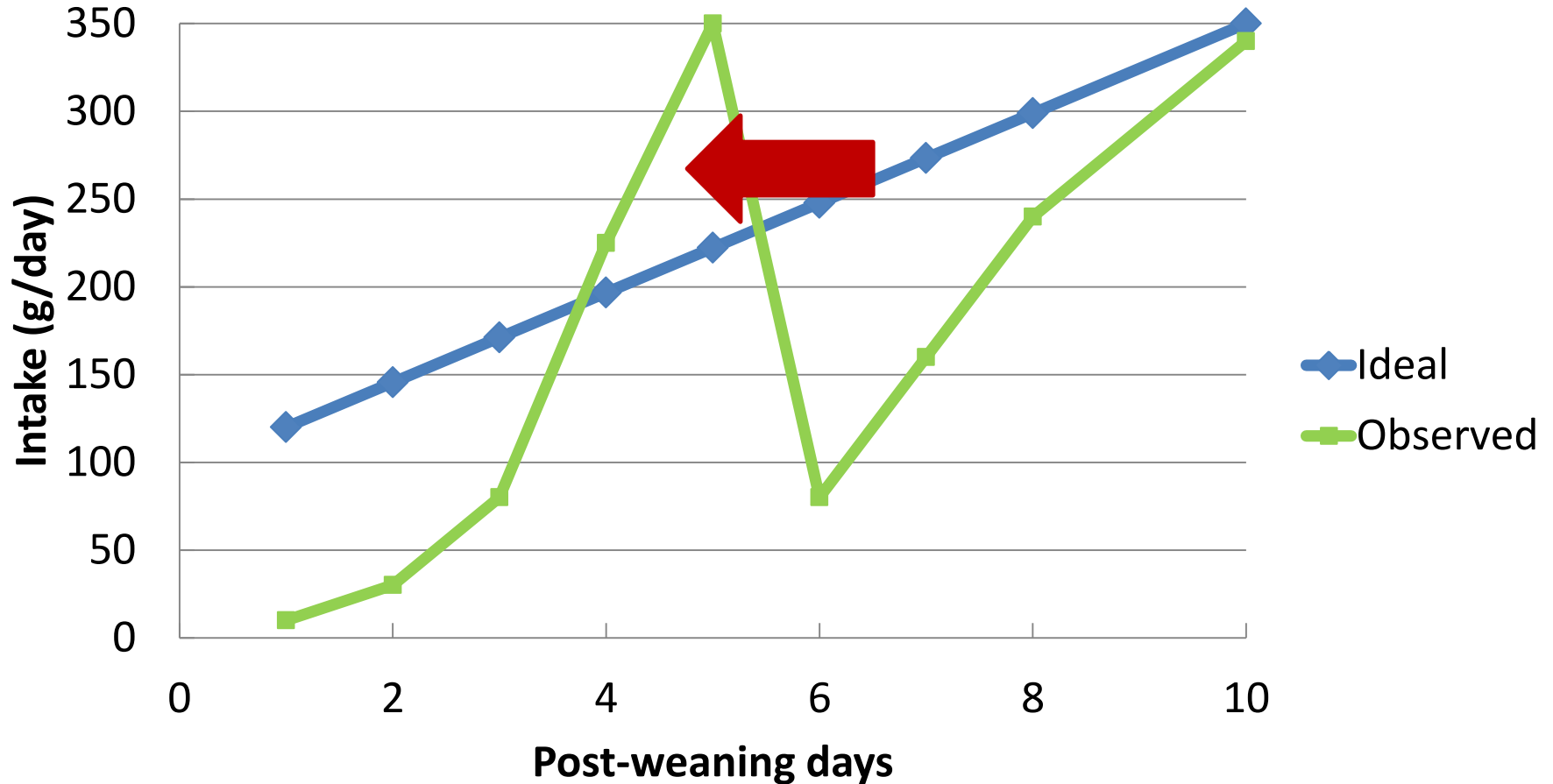


Changes during the first days post-weaning in piglets



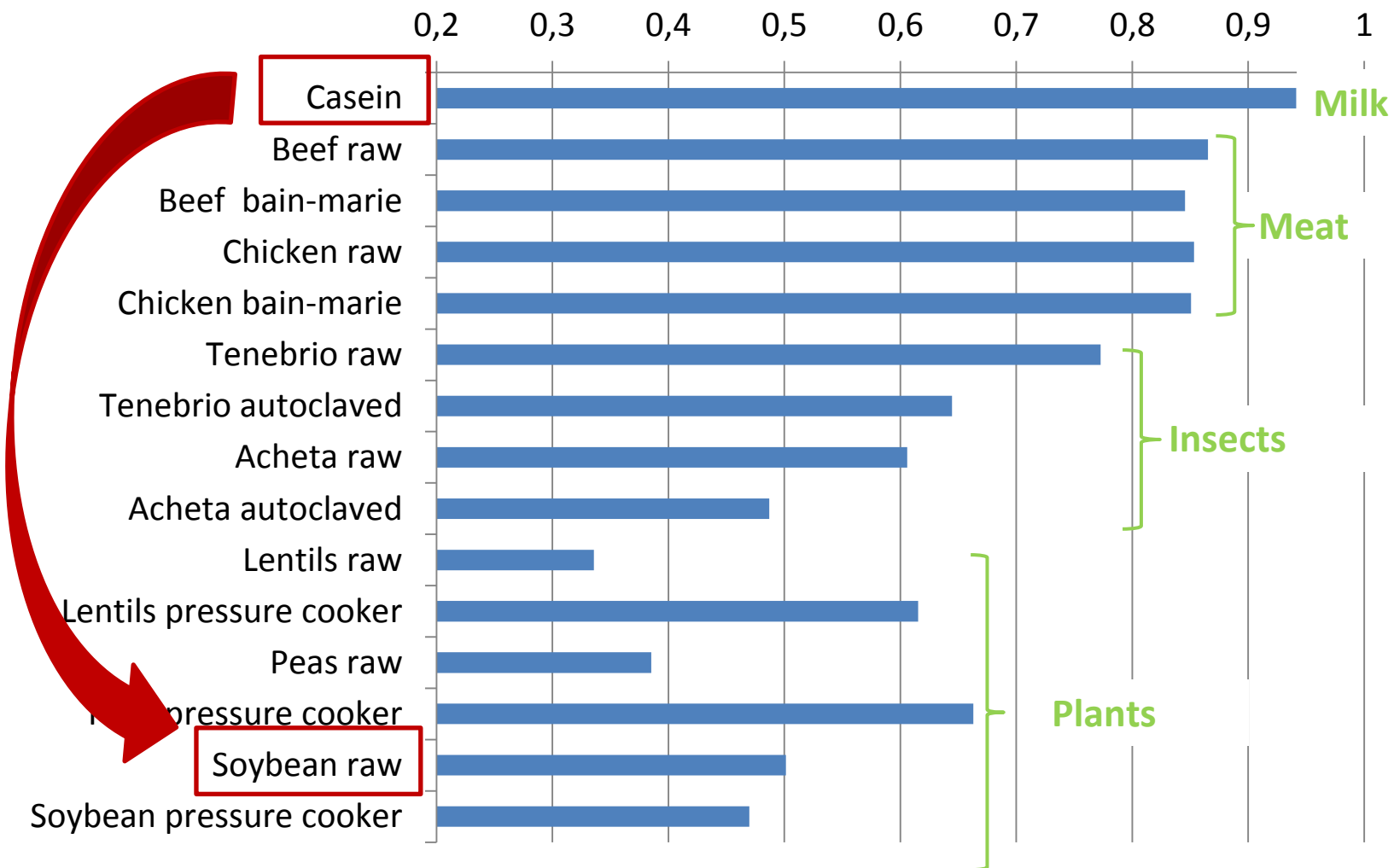
(Molist et al., in press)

Feed intake around weaning



Plant protein of lower quality?

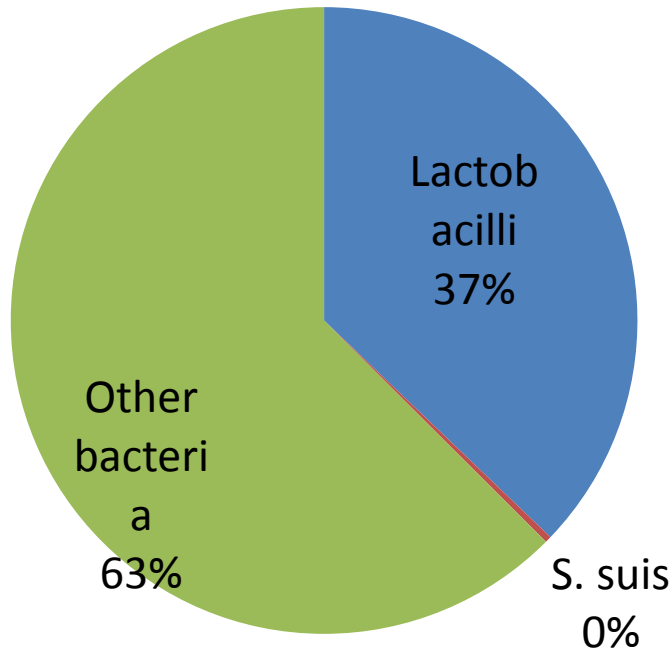
In vitro digestibility of various protein sources



(Poelaert et al, personal communication)

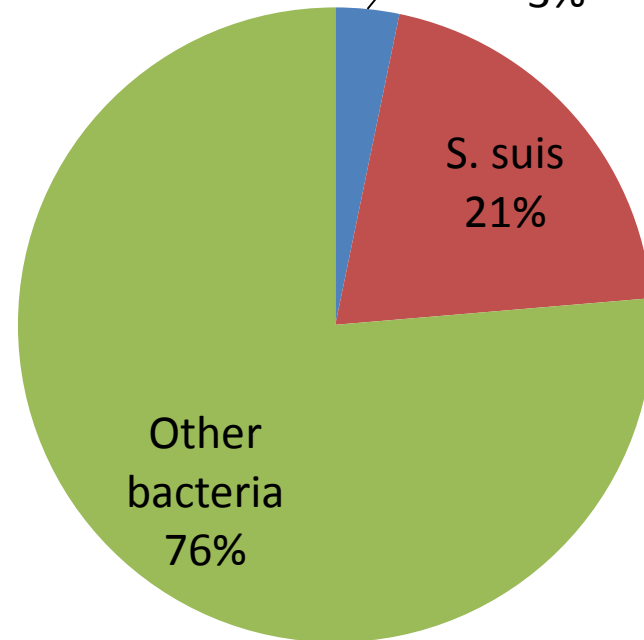
Proportion of bacteria in ileal digesta after before and just after weaning

Day 21



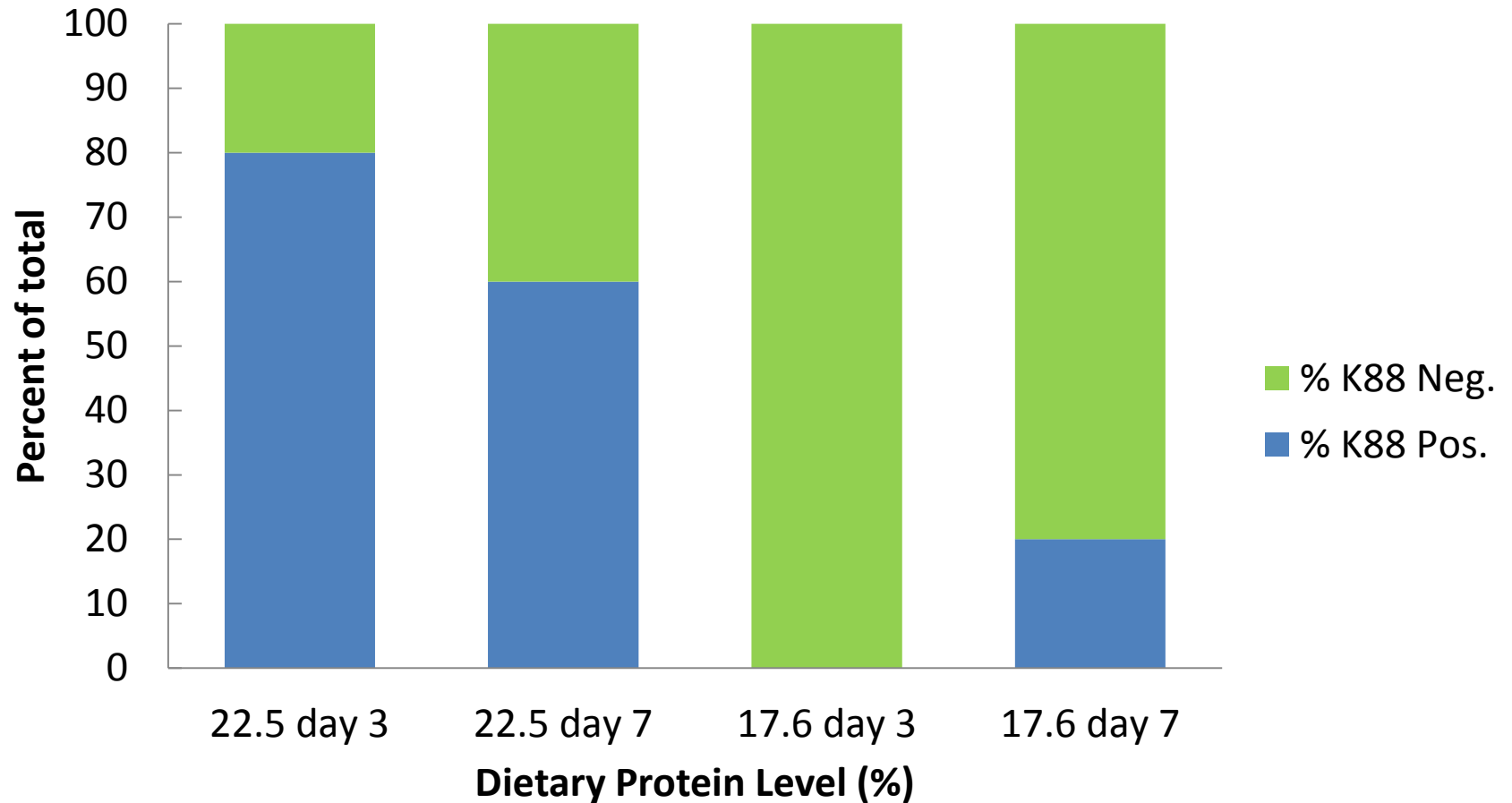
Total = $\log 9,72 \pm 0,19$

Day 24

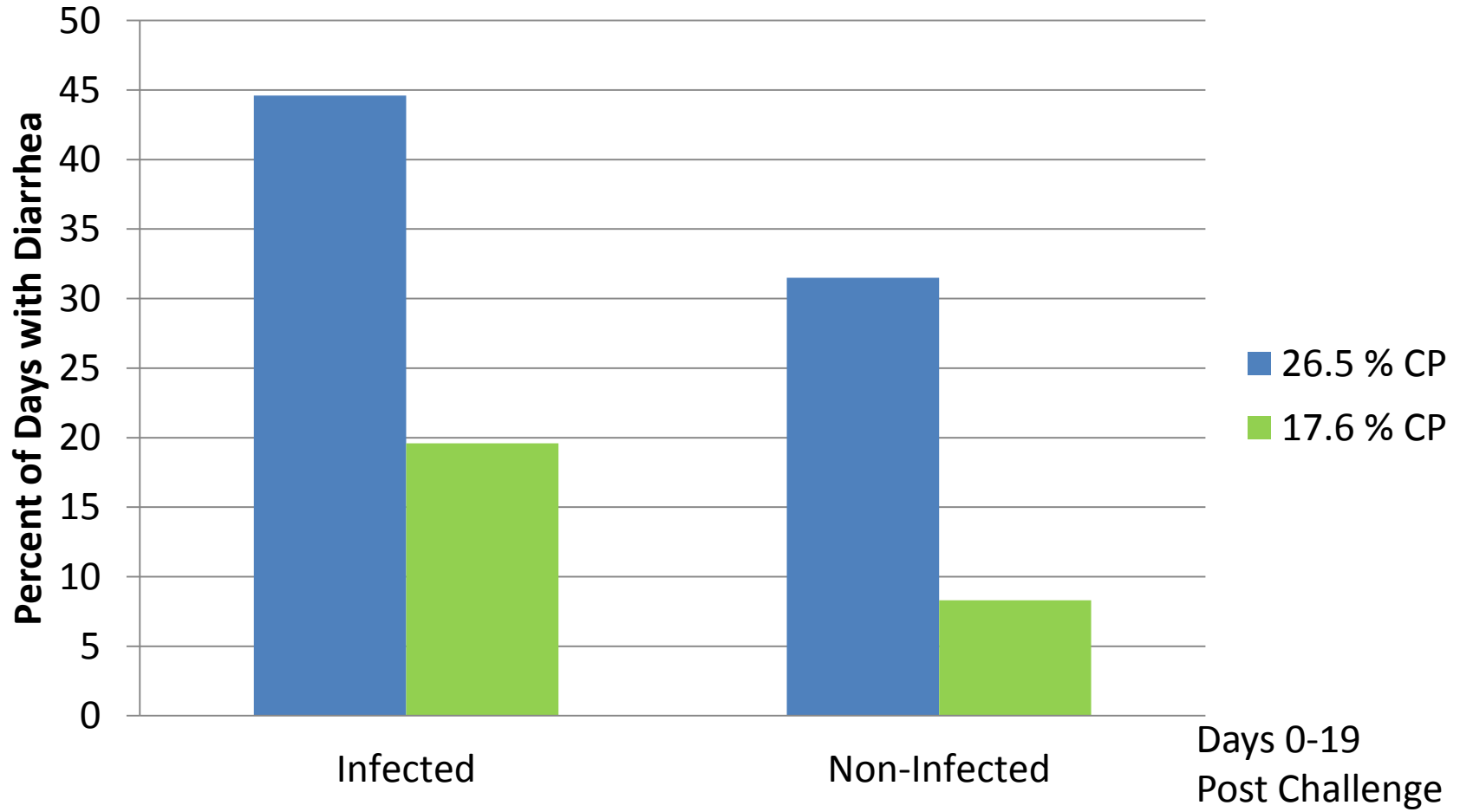


Total = $\log 8,29 \pm 0,77$

High CP Protein Diets and *E. coli* prevalence



High CP diets/*E. coli* challenge and days in diarrhea

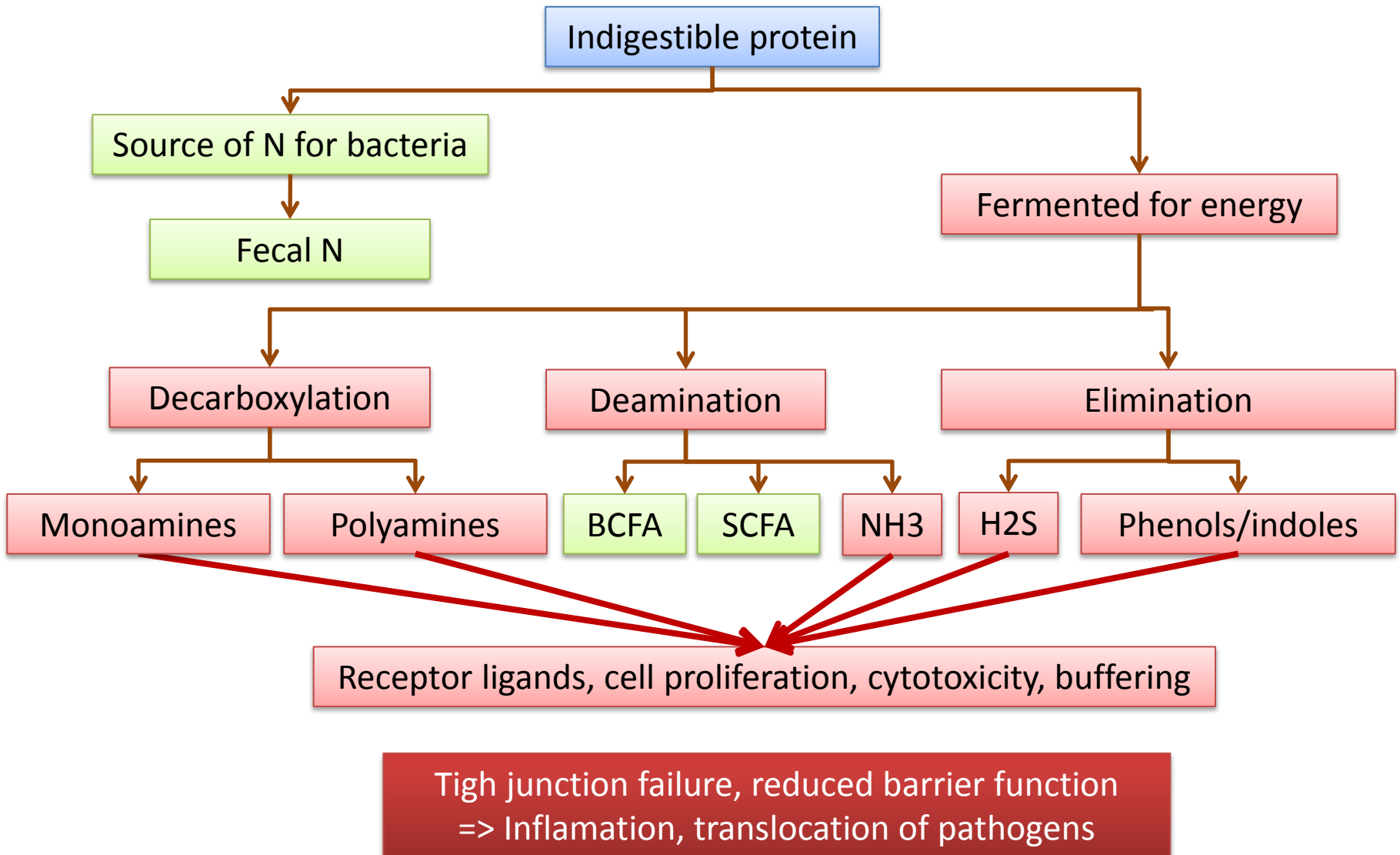


Consequences?

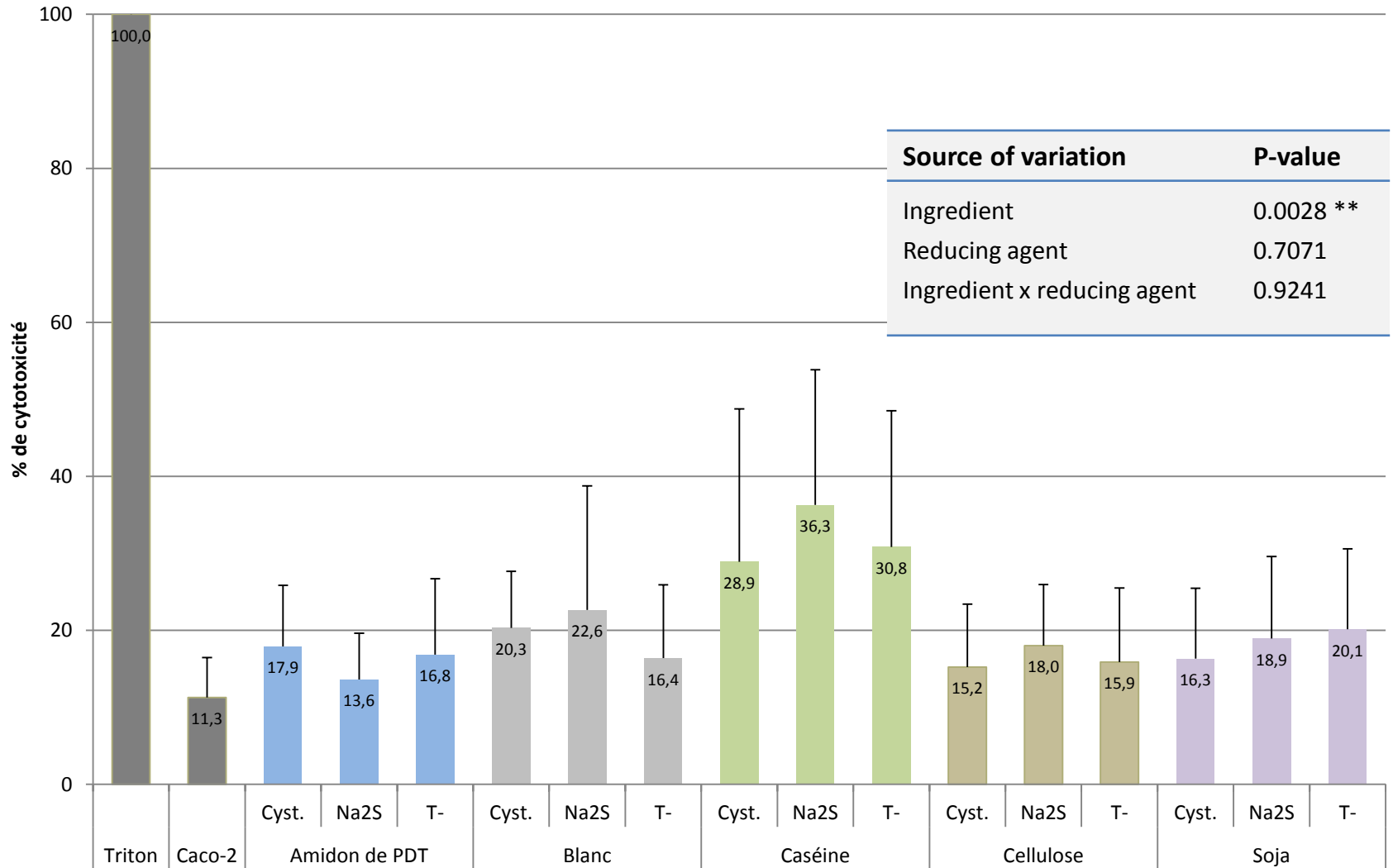
- For years, systematic supplementation of starter diets with antibiotics at weaning to prevent overgrowth of pathogens

Why is CP content and digestibility so critical in piglets?

The evils of protein fermentation in the intestines of piglets



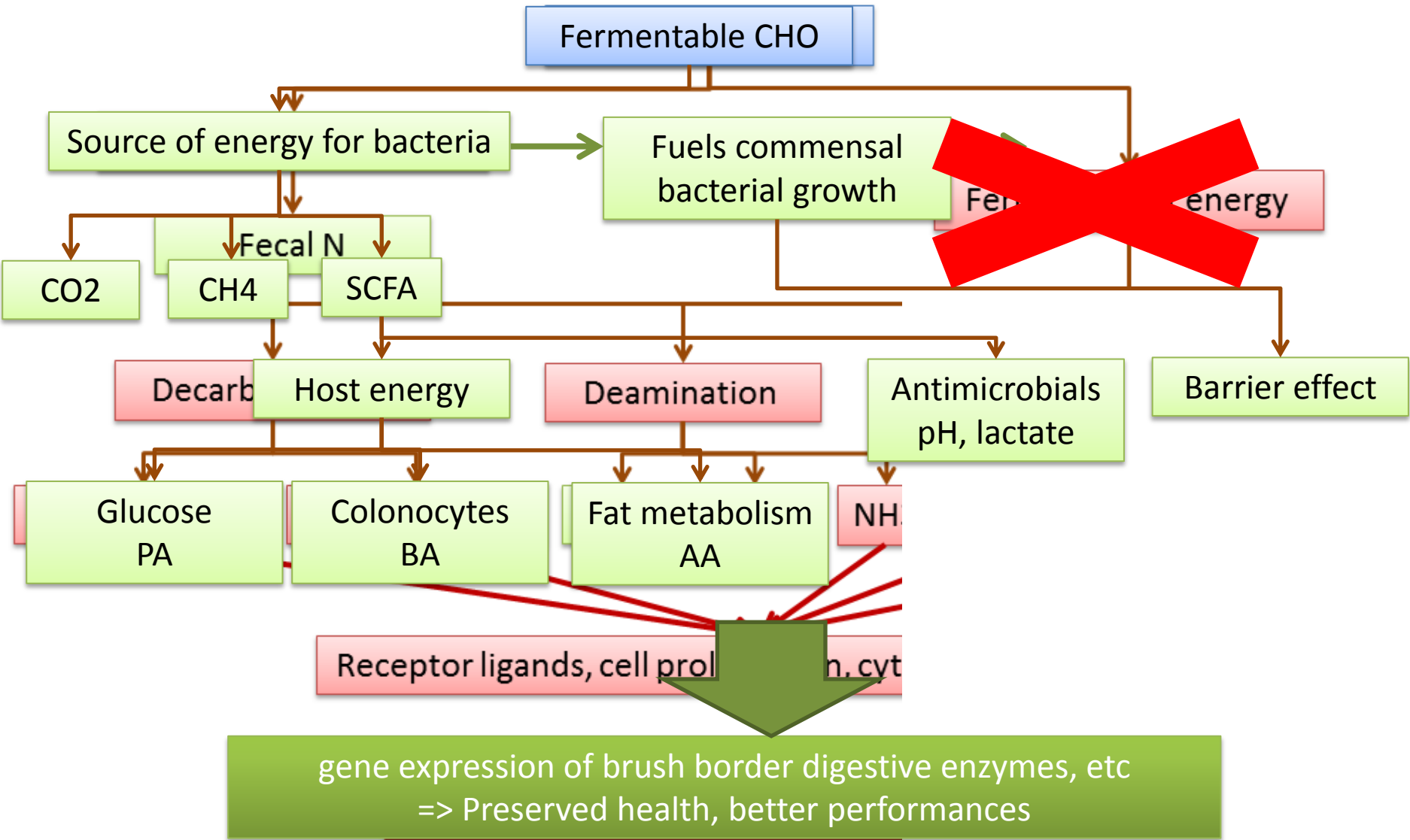
Toxicity of protein fermentation metabolites on CACO-2 cells



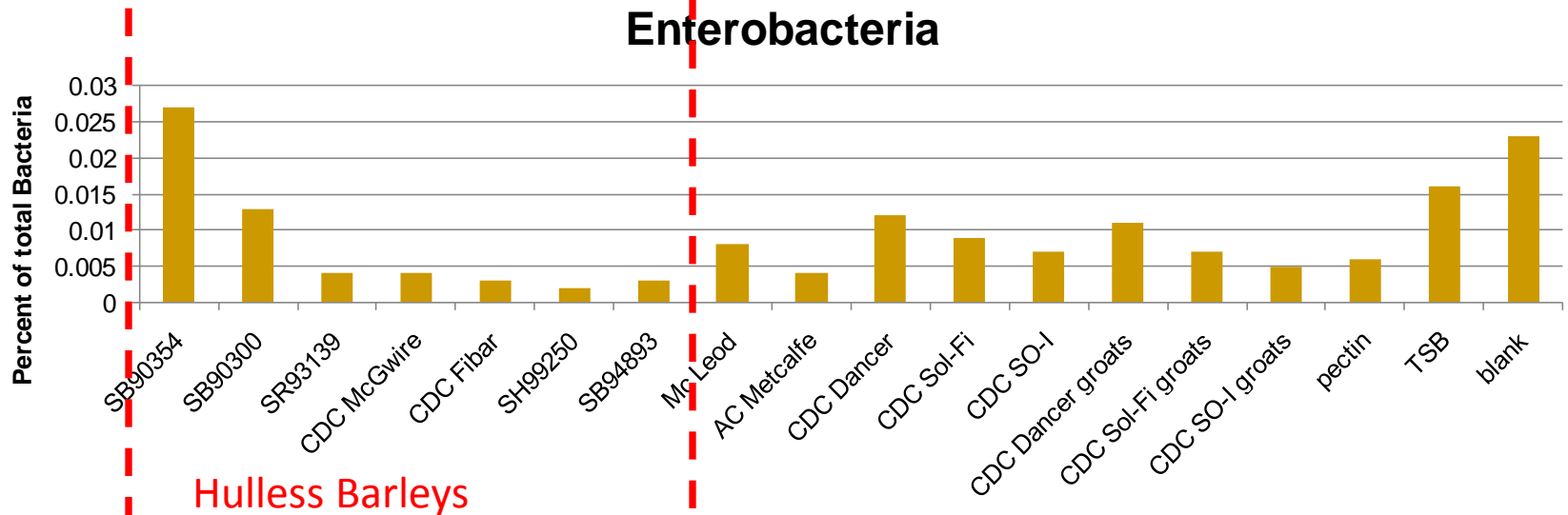
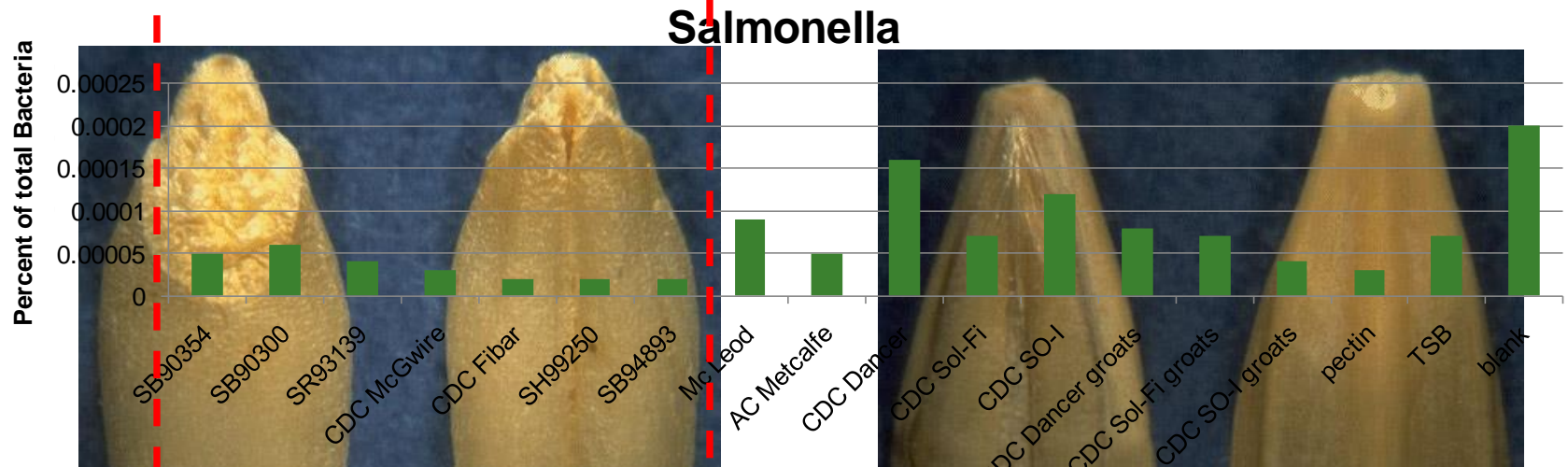
Strategies now?

- Delayed weaning 21 => 28 d
- Reduce CP content of diets and supplement with synthetic AA
- High level of Cu and Zn in weaners diets
- Addition of pro- & prebiotics
 - Lactobacilli, Bacilli, yeasts, yeasts extracts, oligosaccharides, DF, etc.

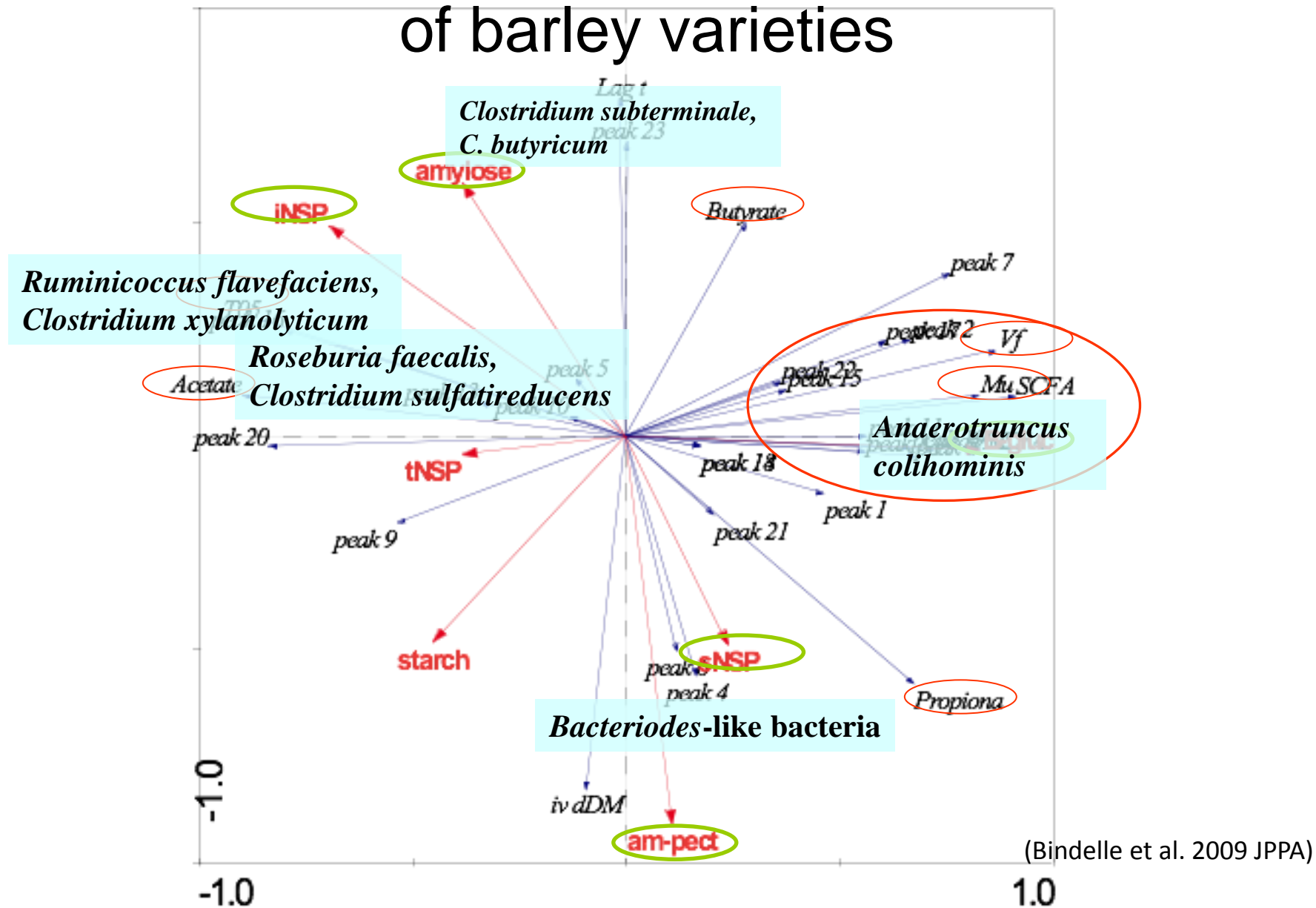
Indigestible CHO to fight PWS?



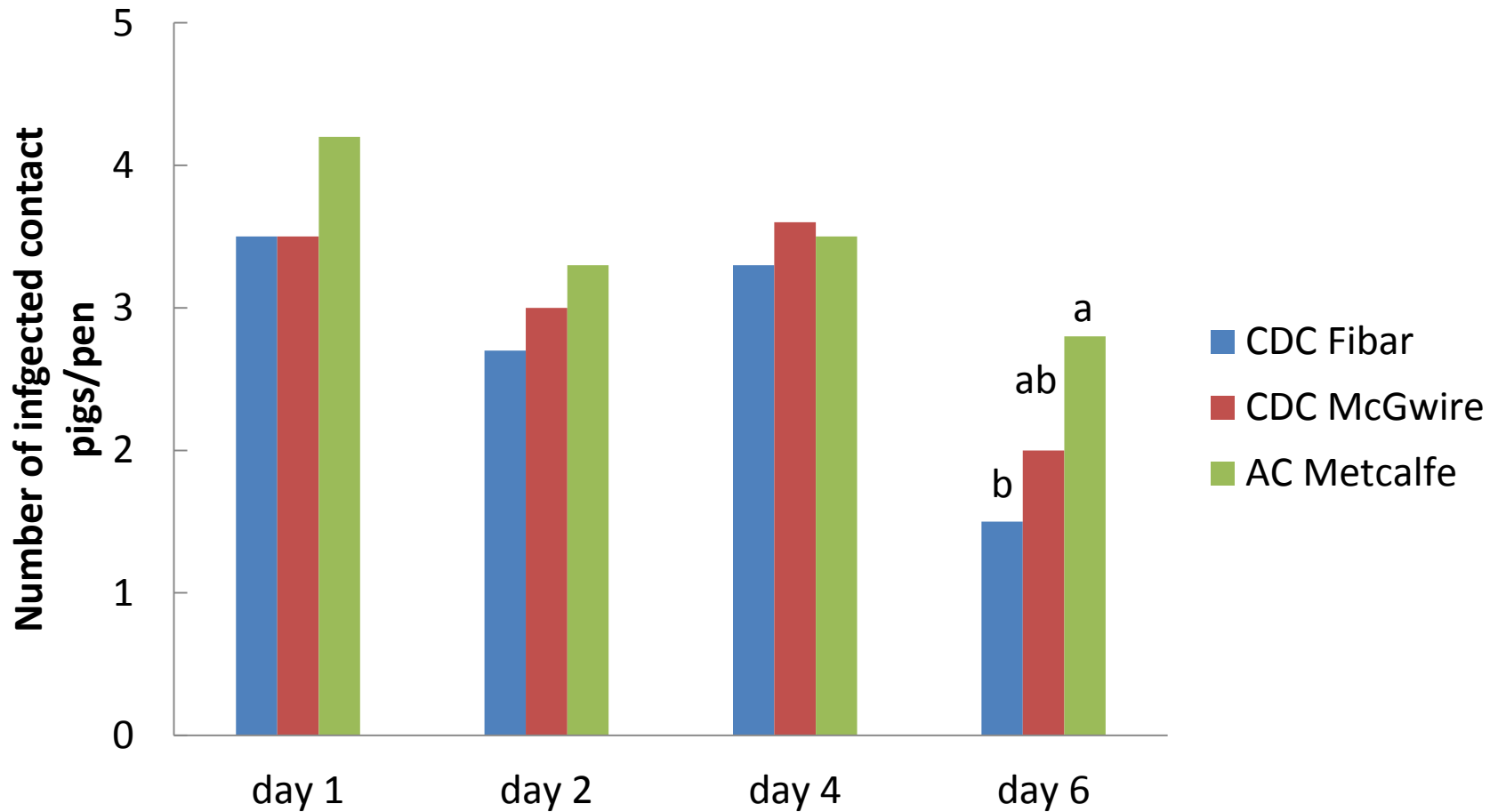
Hulled vs. hulless barleys in *in vitro* challenge



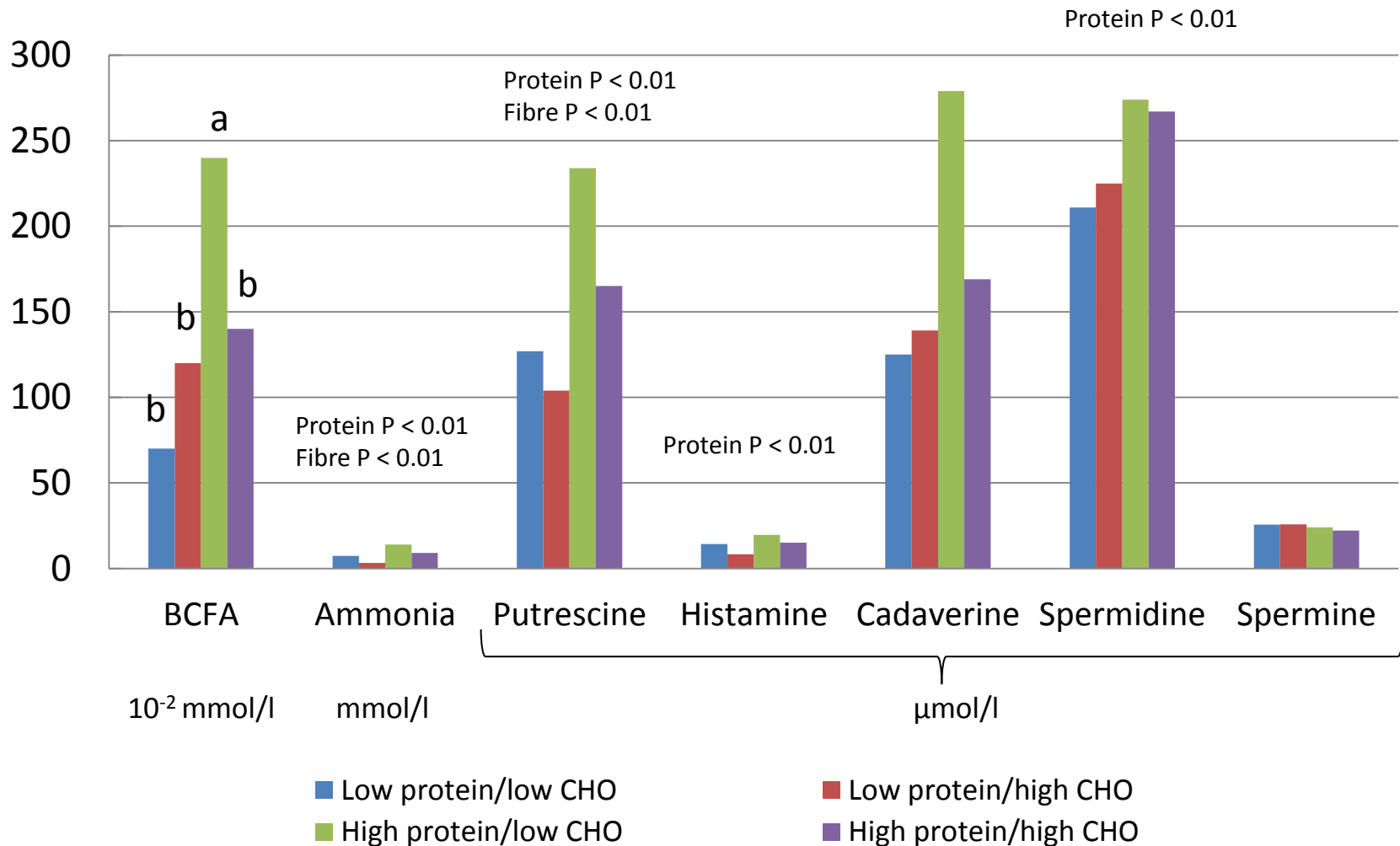
Ordination model explained by fibre content of barley varieties



Effective protection of hulless barleys against Salmonella transmission

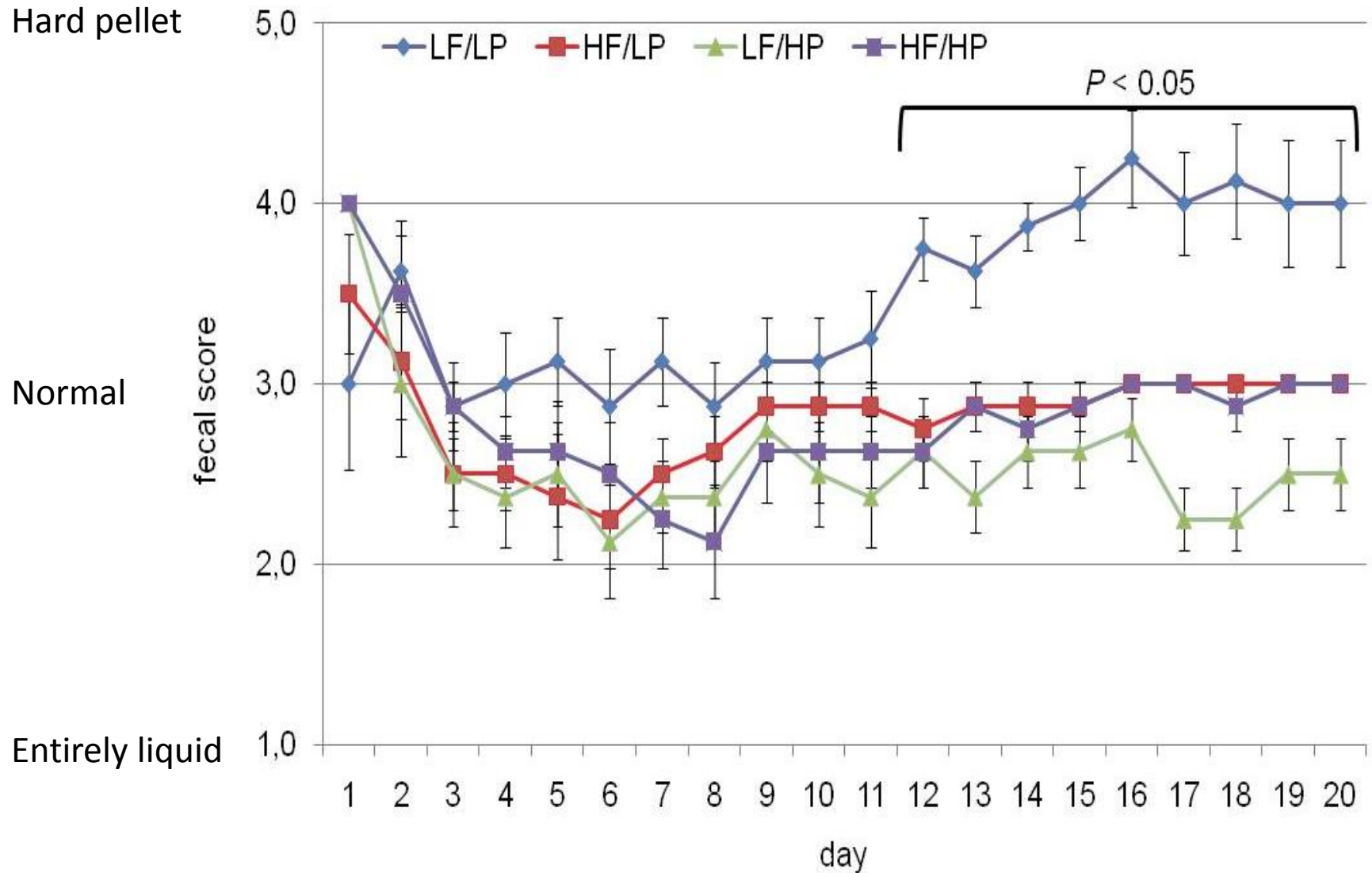


Using SBP to reduce soybean autoclaved protein fermentation?

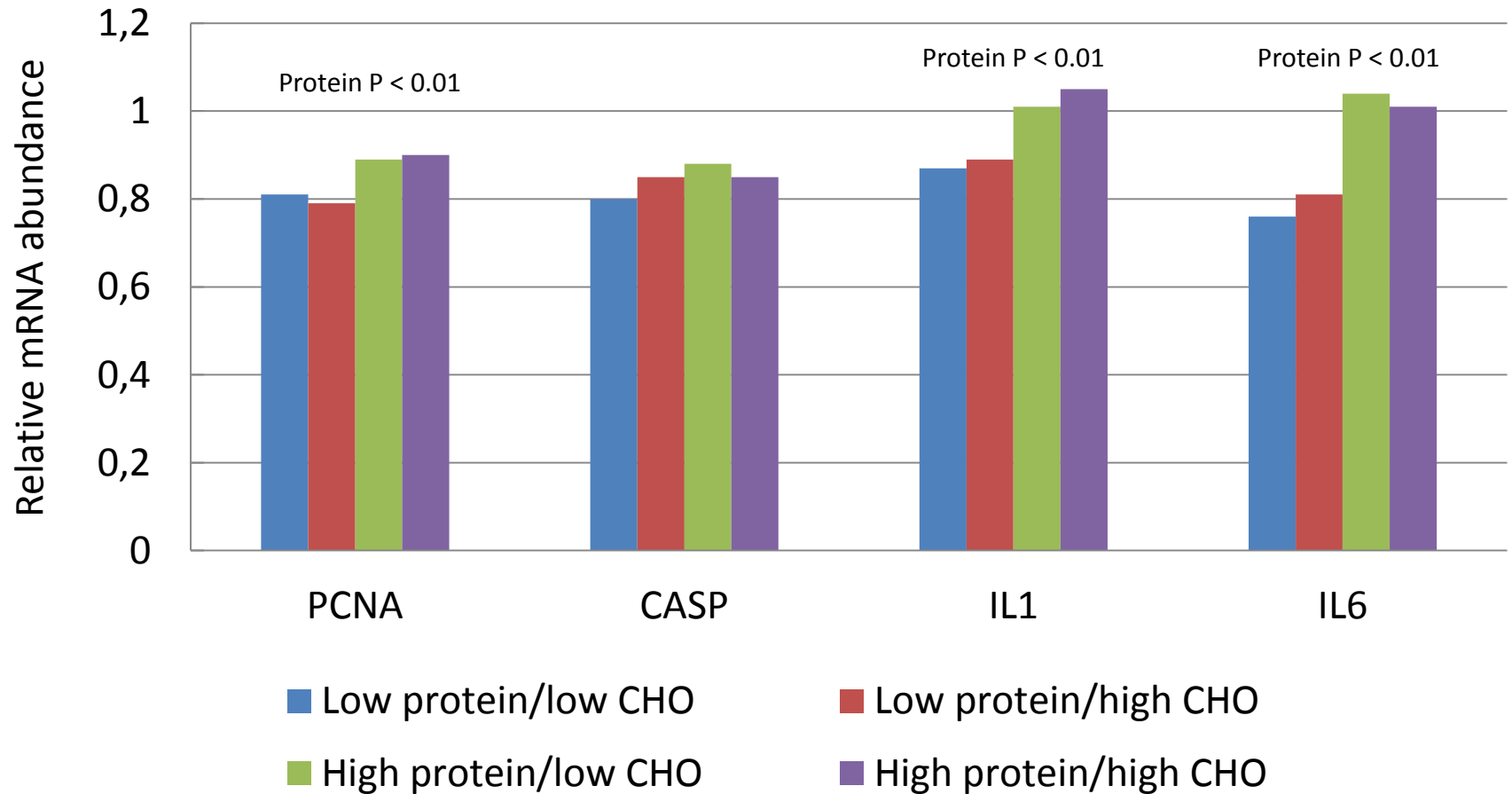


And its consequences?

Well...



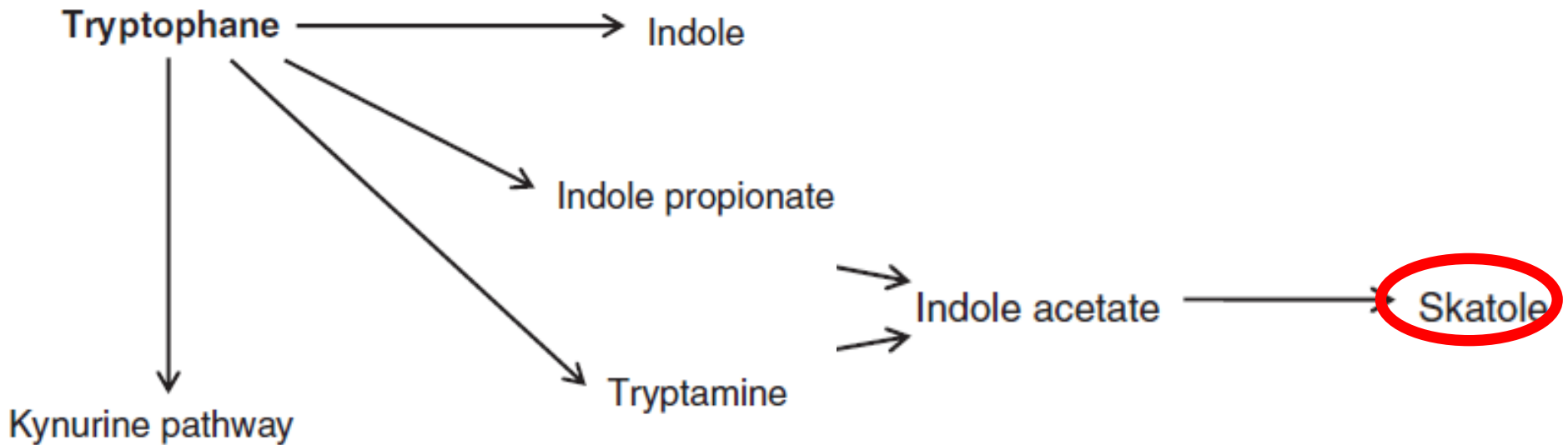
... not on all points



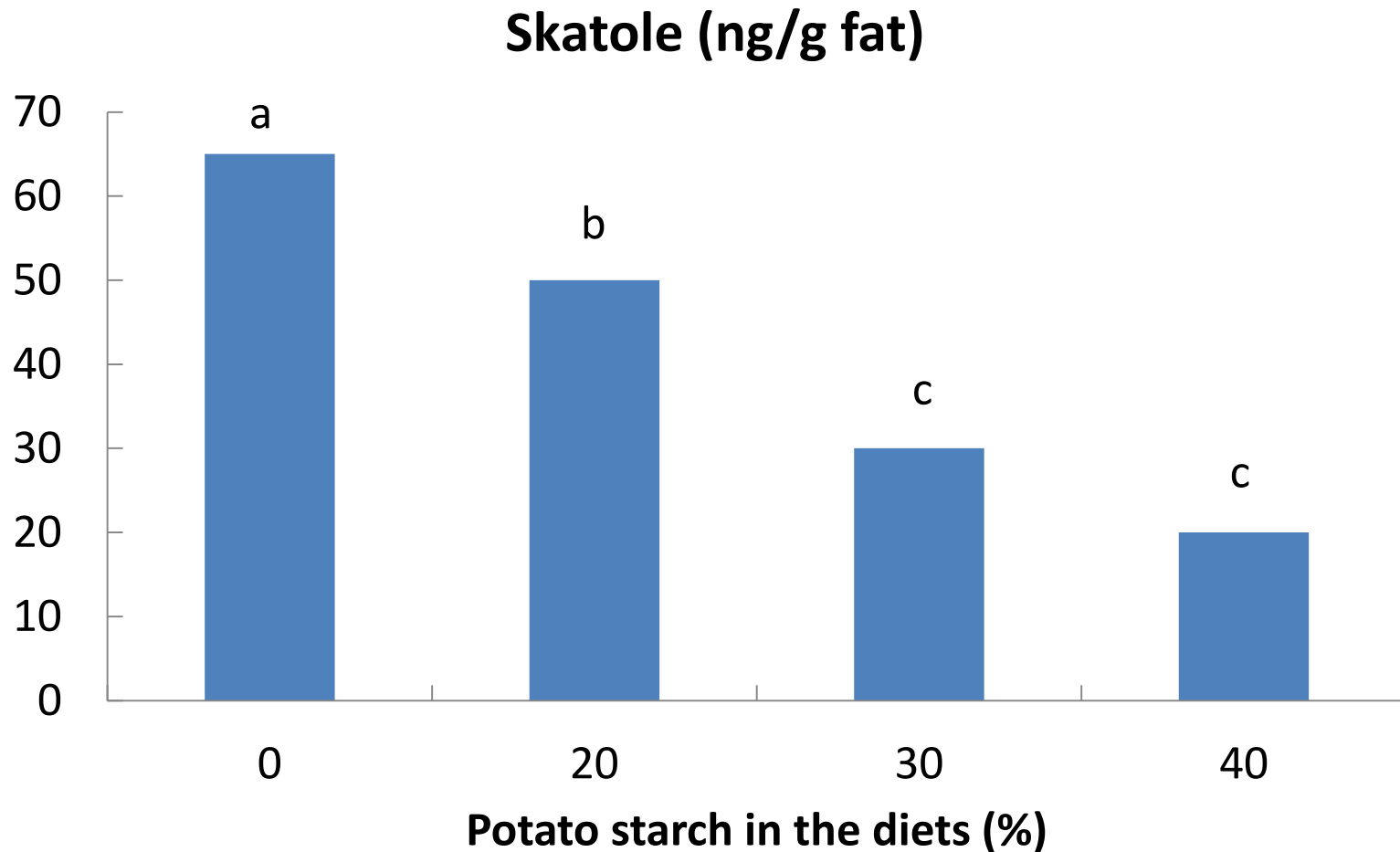
But weaning is not the only issue related to protein fermentation in pigs...



Tryptophane fermentation pathways



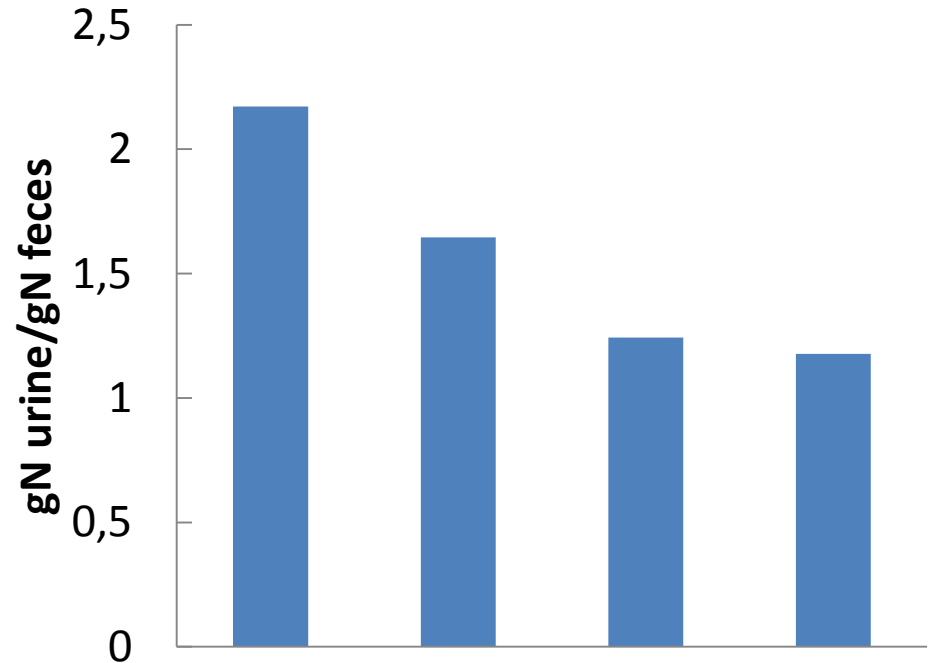
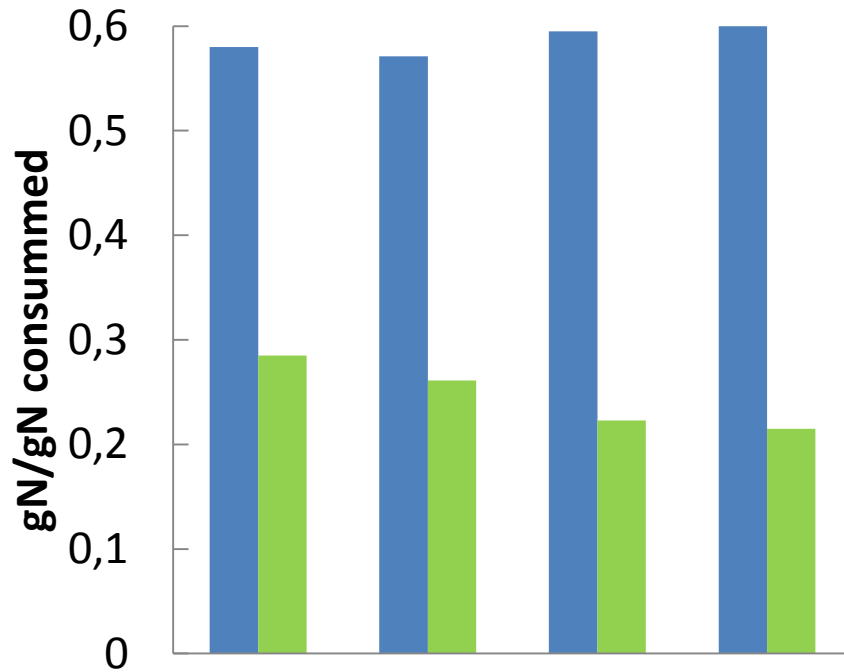
Modulating backfat skatole content via intestinal fermentation



Protein fermentation leads to increased environmental footprint

- Excess in protein fermentation shifts the form of N-excretion in pigs from protein to urea
- Problem of stability in the manure => volatility, leaching and less synchrony with plant uptake

N excretion pathways and fermentable fiber



Standard diet 10% SBP 20% SBP 30% SBP

■ N retention ■ Urinary-N
P = 0,63 Linear P < 0,01

Quadratic P = 0,044

Conclusion

Avoiding protein fermentation in the pigs intestines
= positive for health, meat taste and environment

Pending question:

If fermentable fibre is efficient at reducing protein fermentation and susceptibility to *Salmonella*, why does it not improve inflammatory parameters?

Who conducted those researches

University of Saskatchewan

Andrew Van Kessel

Gita Malik

Jason Marshall

Prairie Swine Centre

Carlos Montoya

Pascal Leterme

Free University of Berlin

Jürgen Zentek

Robert Pieper

University of Liège

Christelle Boudry

Christine Poelaert

Yannick Blaise

Tham Tran

Georges Daube

Bernard Taminiau

Catholic University of Louvain

Géraldine Nollevaux

Yves-Jacques Schneider

*Walloon Centre for Agricultural
Research*

José Wavreille