HQP23
LATAM

What are the challenges for Intestinal health?

Jéssica Barbosa
University of Saskatchewan, Canada

High Quality Pork Seminars

MSD Animal Health

Dr. Yadu Moss
Ayurveda Doctor

“ Take care of your gut first, and it will take care of everything else.”

Dr. Yadu Moss
TEDx Talks – June 2023

Ashta Churnam
Powder

Ho Quoc Tuan (2023)
VNExpress International

Ho Quoc Tuan (2023)
VNExpress International

PIG PROGRESS

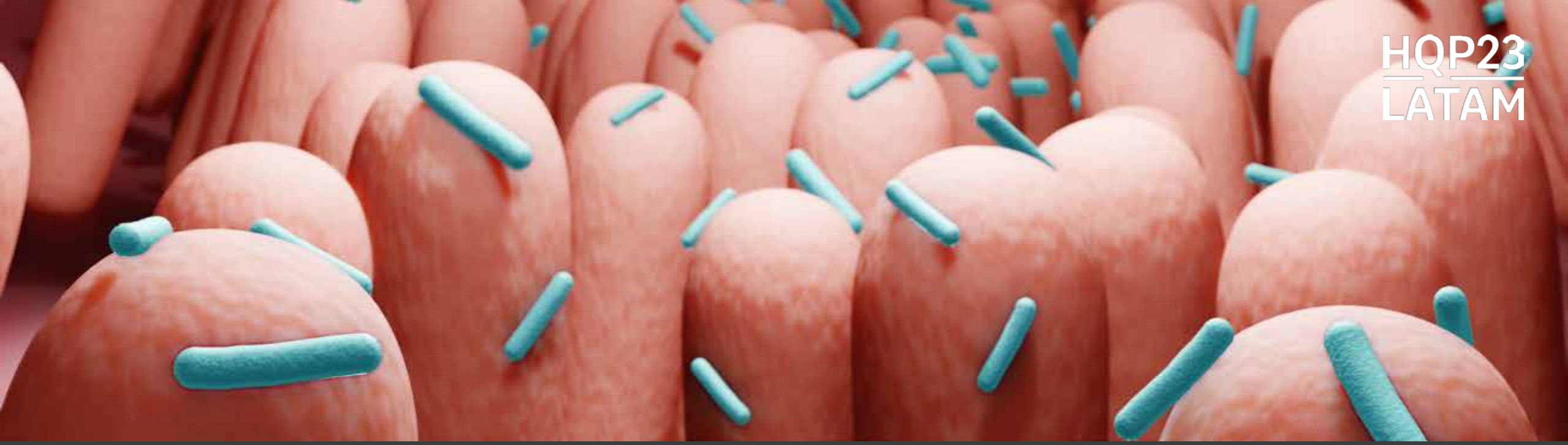
Piglet gut health: An economic proposition

06-03-2020 | Health | Health/Nutrition | Article

What are the challenges for Intestinal health?

HQP23
LATAM

Early life events impact the whole life of the pigs?



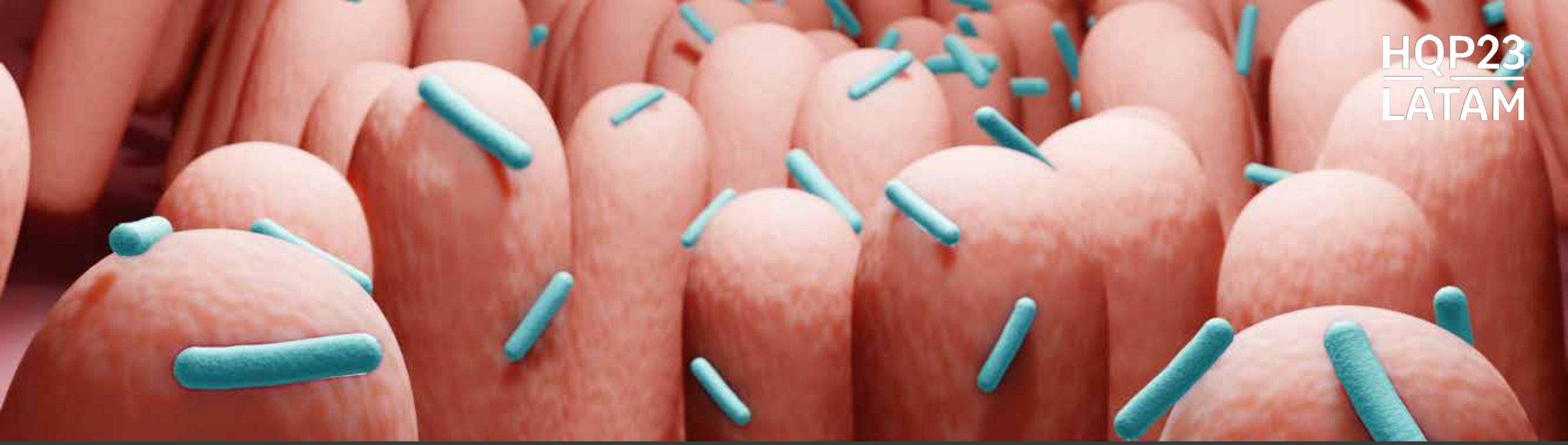
HQP23 LATAM

“Early-life microbial colonization is the most important time for shaping intestinal and immune development”

High Quality Pork Seminars

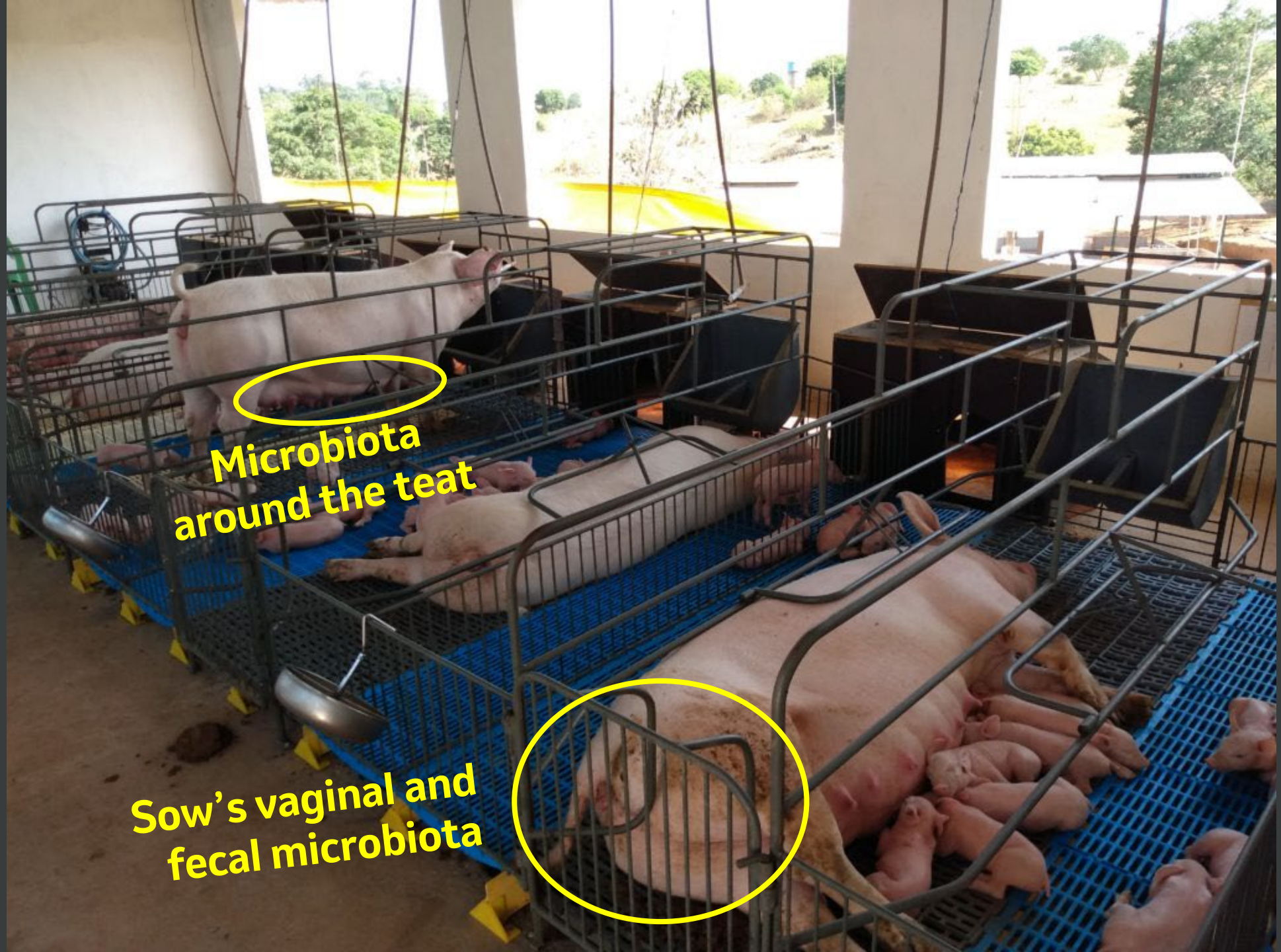
Nowland et al. (2022)

MSD Animal Health



“Perturbations to the microbiota during this time having long-lasting negative implications for the host”

Nowland et al. (2022)

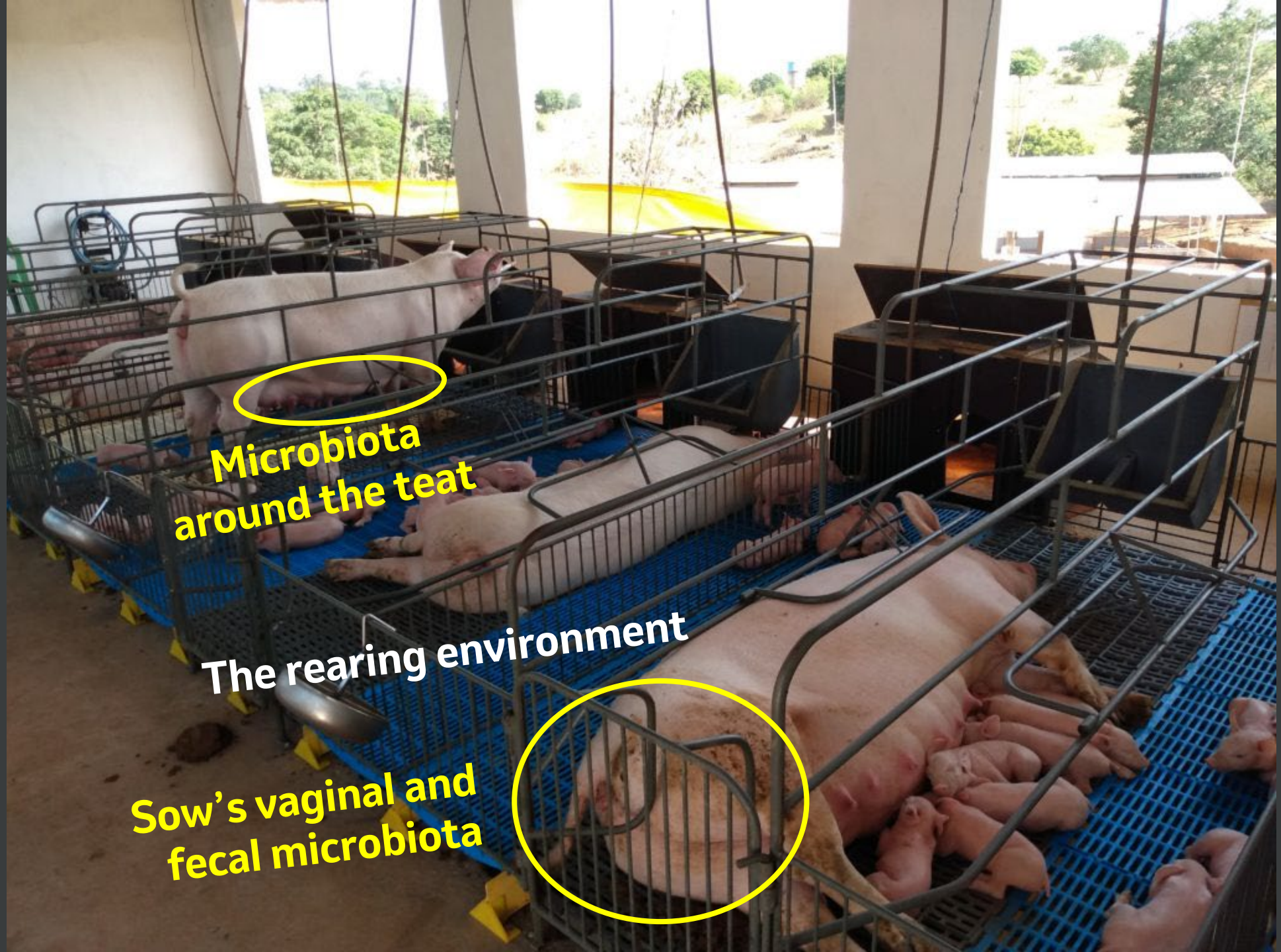


HQP23
LATAM

High Quality Pork Seminars

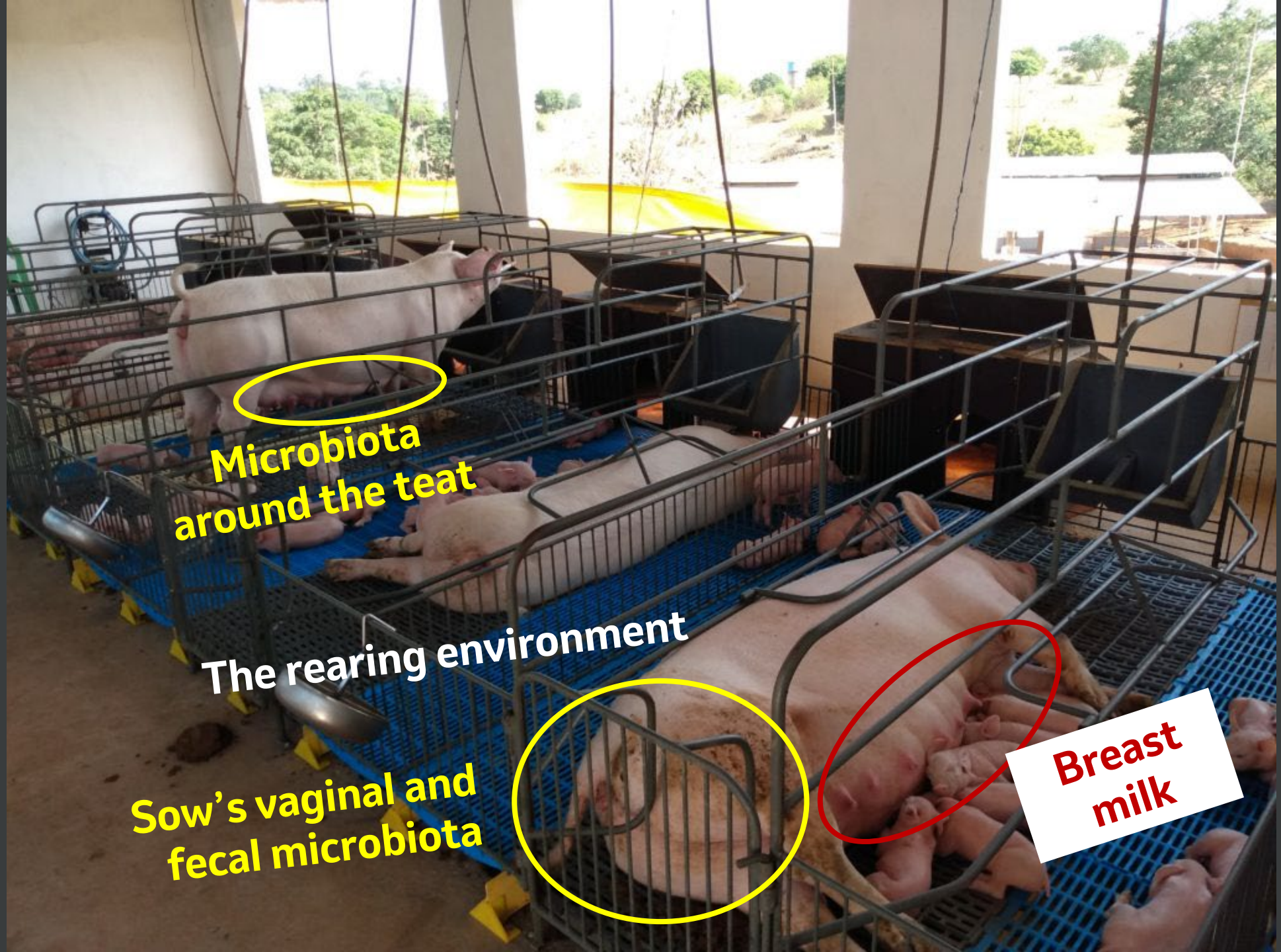
MSD Animal Health

Jefferson Bandeira (2021)



HQP23
LATAM

Jefferson Bandeira (2021)



HQP23 LATAM

High Quality Pork Seminars

MSD Animal Health

Jefferson Bandeira (2021)

HQP23
LATAM

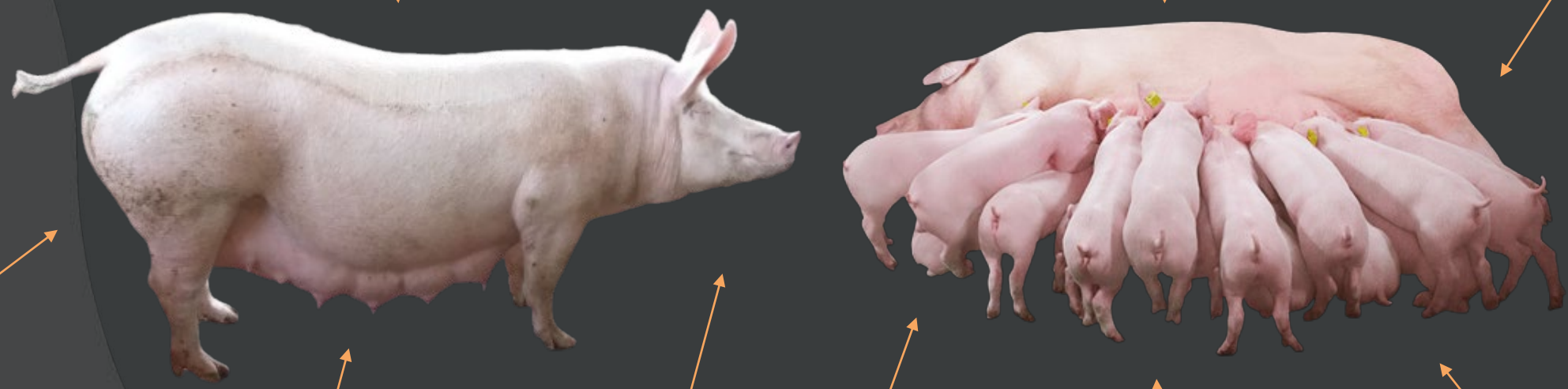
Body condition

Gestation phase

Peripartum

Lactation

Heat stress



Health

Oxidative stress

Welfare

Hyperprolificity

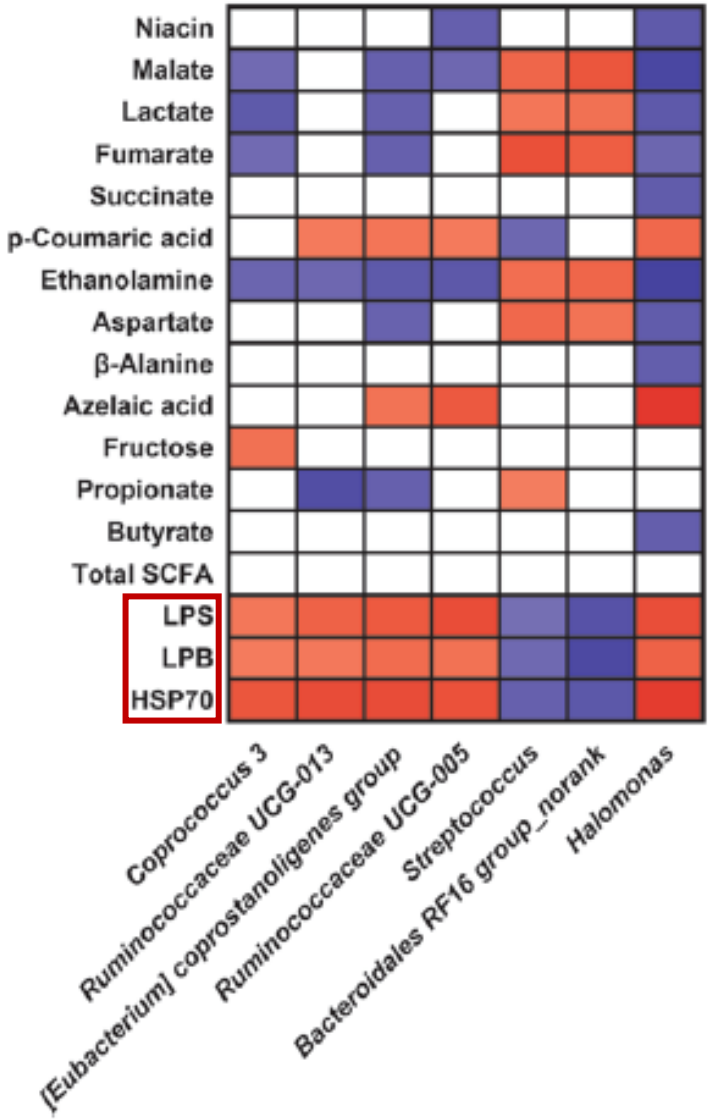
Nutrition

Environmental condition

Lallemand

HS-induced maternal microbial and metabolic changes during late gestation

HQP23 LATAM



Positive correlation

Negative correlation

HS = 28–32 °C;
HS sows: n = 6

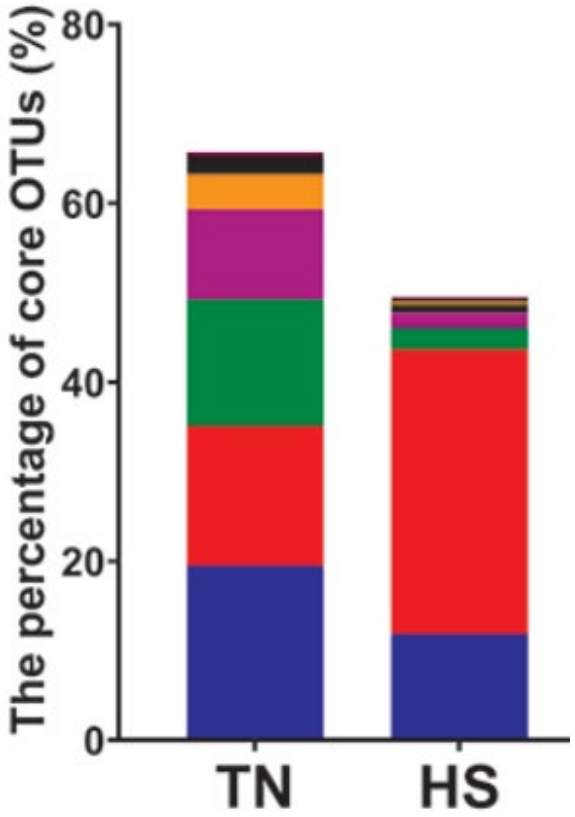
He et al (2019)

MSD Animal Health

HEAT STRESS

HS-disrupts maternal microbial transmission

HQP23 LATAM



- *Streptococcus*
- *Klebsiella*
- *Intestinibacter*
- *Terrisporobacter*
- *Fusobacterium*
- *Romboutsia*
- *Turicibacter*
- *Escherichia-Shigella*
- *Clostridium sensu stricto 1*

Potential pathogen

"Compromised intestinal energy utilization, barrier, and immune function of neonatal piglets."

TN: (18-22℃; n=6)

HT: (28-32℃; n=6)

He et al (2020)

Does the sow's body condition interfere with intestinal health?

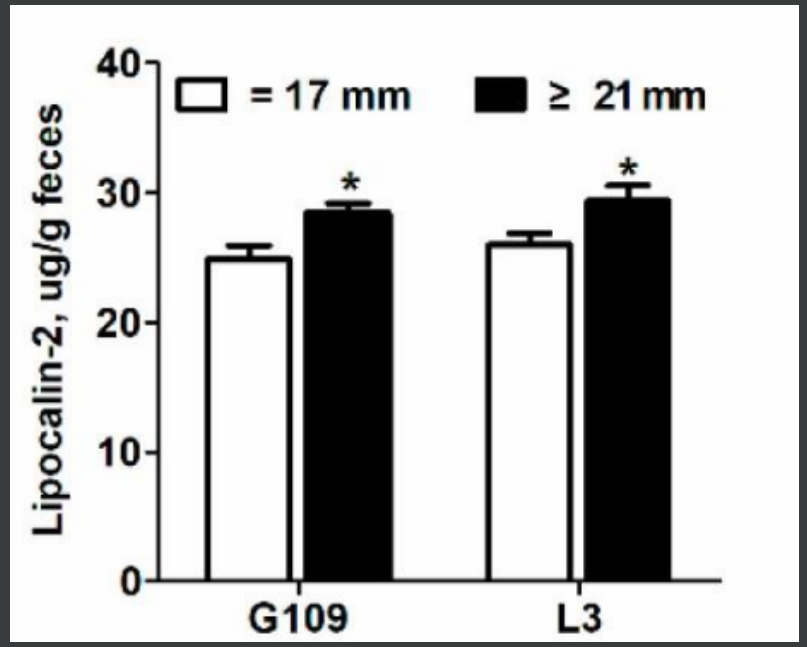
HQP23 LATAM

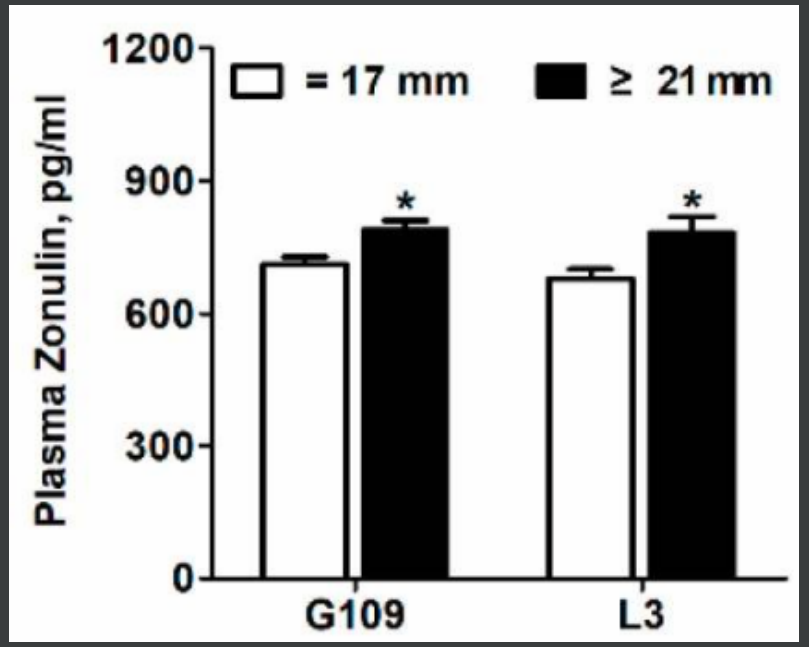



Hog Slat site

Excessive backfat thickness during late pregnancy affects intestinal inflammation and intestinal permeability biomarkers in perinatal sows

HQP23 LATAM





G109 = day 109 of pregnancy (n=30);

L3 = day 3 of lactation (n=30).

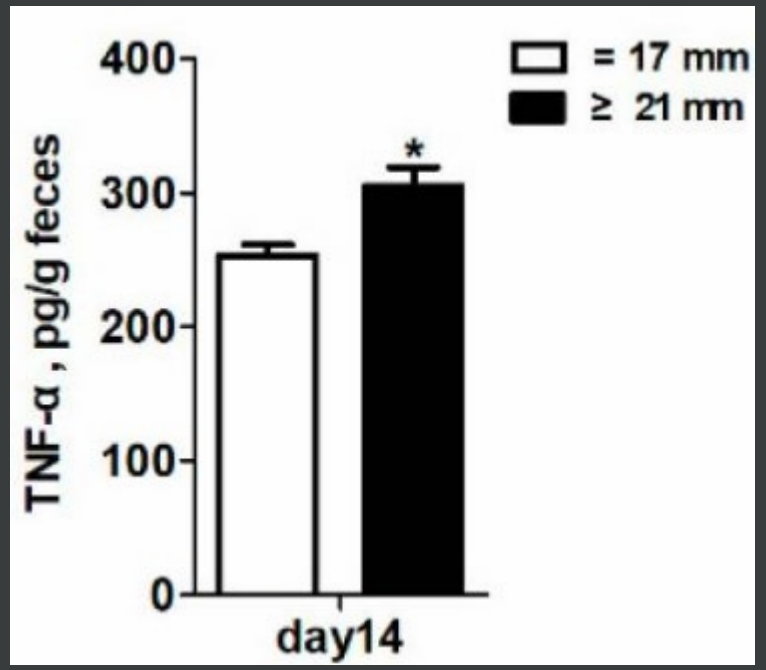
Indicator of intestinal inflammation

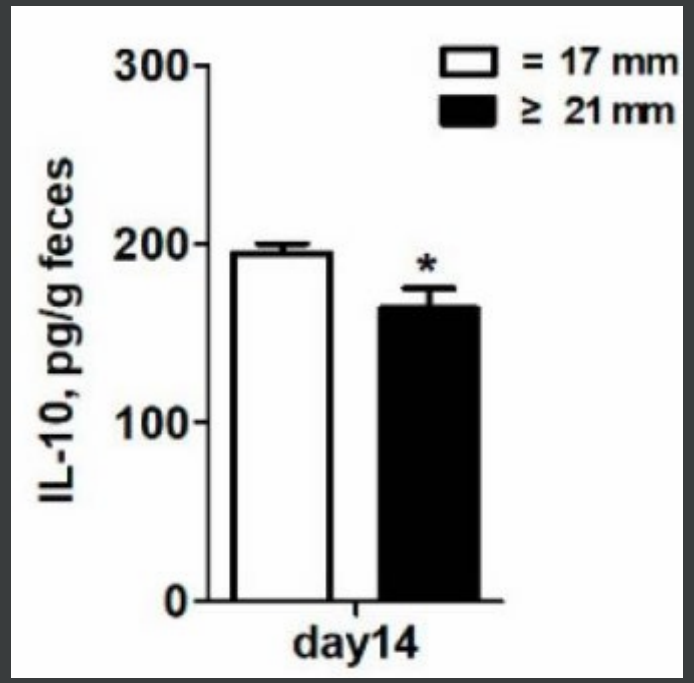
Reflect intestinal permeability

Cheng et al. (2020)

Excessive backfat thickness during late pregnancy affects intestinal inflammation cytokines in offspring piglets

HQP23 LATAM





Day14 = 14 days of lactation;

n = 60 piglets

Cheng et al. (2020)


HQP23
LATAM
The preventative use of antibiotics in early life
MSD

OPEN ACCESS Freely available online

PLOS ONE

Early-Life Environmental Variation Affects Intestinal Microbiota and Immune Development in New-Born Piglets

2014

Dirkjan Schokker[1*], Jing Zhang[2], Ling-li Zhang[2], Stéphanie A. Vastenhouw[3], Hans G. H. J. Heilig[2], Hauke Smidt[2], Johanna M. J. Rebel[3], Mari A. Smits[1,3]

Parenteral single dose at **day 4** of age: affected the composition and diversity of gut microbiota and downregulated in chemokine and toll-like receptors at **day 8 after birth**.

Use of antibiotics at early age can affect the gut microbiota composition and diversity in one-week old piglets

2019

Shah Hasan, Olli Peltoniemi, Juhani Vuorenmaa, Claudio Oliviero

Two antibiotics within **3 days of life**: **decrease** relative abundance of not only **opportunistic pathogenic bacteria** (*Campylobacter*, *Pasteurella*), but also **beneficial bacteria** (*Prevotella*, *Butyrimonas*).

antibiotics

MDPI

Article

Effects of Early Intervention with Antibiotics and Maternal Fecal Microbiota on Transcriptomic Profiling Ileal Mucusa in Neonatal Pigs

2020

Rongying Xu [1,2], Jiajia Wan [1,2], Chunhui Lin [1,2] and Yong Su [1,2,*]

Oral atb at **1-6 days of age**: **negative effect** on **intestinal morphology** at d 7, altered **gene expression profiles** in the ileum at d 7 and 21 of age, and **upregulated chemokines** on day 21.

animals

MDPI

Article

Faecal Microbiota Analysis of Piglets During Lactation

2020

Tanya L. Nowland [1,*], Valeria A. Torok [2], Wai Y. Low [3], Mary D. Barton [4], Kate J. Plush [5] and Roy N. Kirkwood [1]

Parenteral antibiotic at **7 days of age**: **no impacts** on the fecal microbiota.

MSD

Long term effects?

The ISME Journal (2007) 1, 180–183
© 2007 International Society for Microbial Ecology All rights reserved 1751-7362/07 $30.00
www.nature.com/ismej

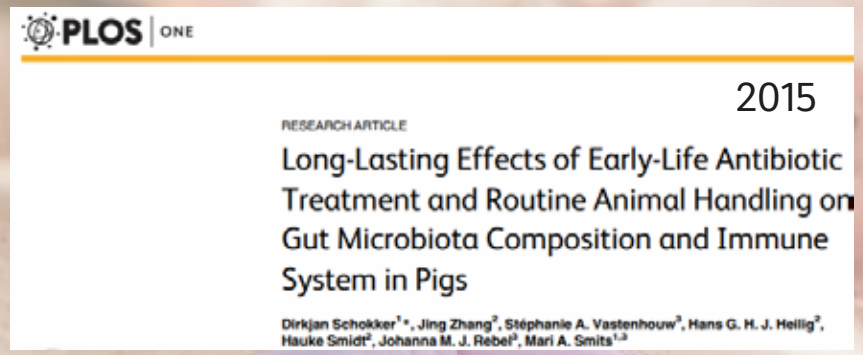
SHORT COMMUNICATION

Parenteral long-acting amoxicillin reduces intestinal bacterial community diversity in piglets even 5 weeks after the administration

Pawel Janczyk[1,4], Robert Pieper[1,4], Wolfgang Bernhard Souffrant[1], Diane Bimczok[2], Hermann-Josef Rothkötter[2] and Hauke Smidt[3]

2007

Atb administration at **1 day of age**: altered its colonic microbiota composition up to at least **5 weeks of age**.



PLOS ONE

RESEARCH ARTICLE

Long-Lasting Effects of Early-Life Antibiotic Treatment and Routine Animal Handling on Gut Microbiota Composition and Immune System in Pigs

Dirkjan Schokker[1]*, Jing Zhang[2], Stéphanie A. Vastenhouw[3], Hans G. H. J. Heilig[2], Hauke Smidt[2], Johanna M. J. Rebel[3], Mari A. Smits[1,3]

2015

Parenteral atb at **4 day** of age had **long-lasting effects** on the gut: **higher expression of ileal tissue immune-related genes** at **day 55**, and **lower microbiota diversity** at **day 176**.

animals

MDPI

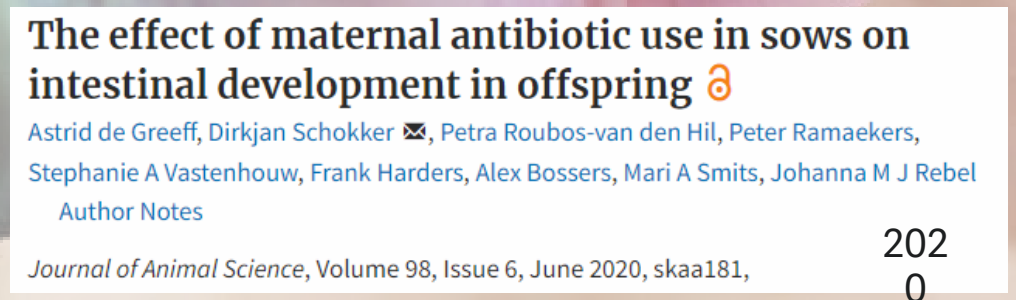
Article

Early Parenteral Administration of Ceftiofur has Gender-Specific Short- and Long-Term Effects on the Fecal Microbiota and Growth in Pigs from the Suckling to Growing Phase

Ursula Ruczizka [1], Barbara Metzler-Zebeli [2,*], Christine Unterweger [1], Evelyne Mann [3], Lukas Schwarz [1], Christian Knecht [1] and Isabel Hennig-Pauka [1,4]

2019

Parenteral atb 12h post partum: differences in the fecal microbiota of piglets at **12, 28 and 97 days**. **Markedly affected microbial diversity** in the fecal microbiota composition, with long-term consequences for **performance**.



The effect of maternal antibiotic use in sows on intestinal development in offspring

Astrid de Greeff, Dirkjan Schokker ✉, Petra Roubos-van den Hil, Peter Ramaekers, Stephanie A Vastenhouw, Frank Harders, Alex Bossers, Mari A Smits, Johanna M J Rebel

Author Notes

Journal of Animal Science, Volume 98, Issue 6, June 2020, skaa181,

2020

Sow in feed antibiotic during **last 7 days of gestation**: changes in the **sow's fecal microbiota diversity**; negatively affected **small intestine** morphology **development** in piglets **up to 5 weeks of age.**

MSD Animal Health

Manop Boonpeng/Shutterstock

Animal welfare and intestinal health

HQP23 LATAM

"Pigs kept in **crowded**, **barren conditions**, with **poor microclimatic conditions**, and subject to **painful and stressful practices** present redirected behaviours, poor immune-competence, and weaker bodies".

Albernaz-Gonçalves et al. (2022)

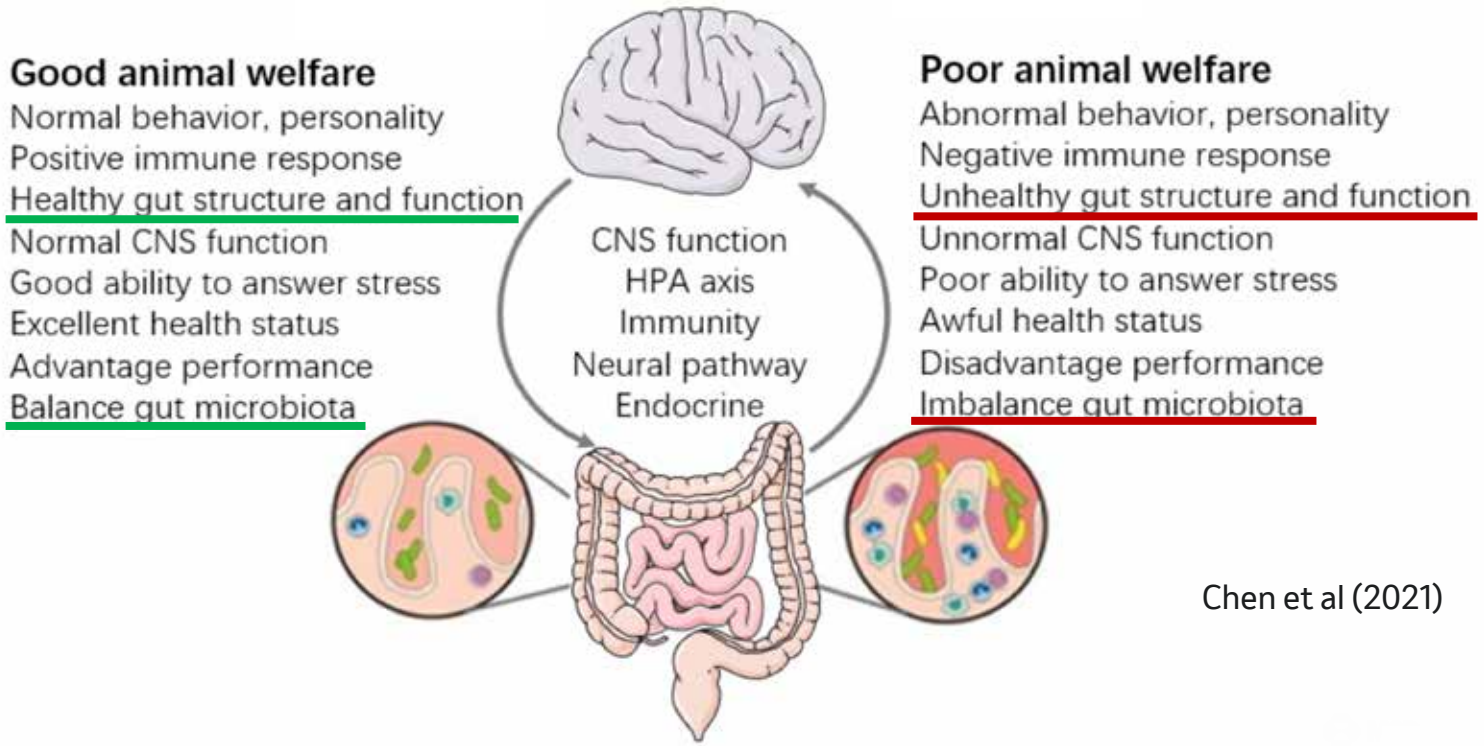
MSD Animal Health

Manop Boonpeng/Shutterstock

"**Environmental** and **psychosocial stressors** play a central role in the initiation and (or) exacerbation of common and burdensome intestinal disorders of humans and animals".

Li et al. (2017)

HQP23 LATAM



Chen et al (2021)

Chronic mixing/crowding stress at weaning

PLOS ONE

OPEN ACCESS PEER-REVIEWED
RESEARCH ARTICLE

2017

Chronic social stress in pigs impairs intestinal barrier and nutrient transporter function, and alters neuro-immune mediator and receptor expression

Yihang Li, Zehe Song, Katelyn A. Kerr, Adam J. Moeser

Published: February 7, 2017 • https://doi.org/10.1371/journal.pone.0171617

Significant alterations in intestinal barrier and nutrient transport function.

Social stress at weaning

Contents lists available at ScienceDirect

Animal

The international journal of animal biosciences

ELSEVIER

202
3

Influence of body lesion severity on oxidative status and gut microbiota of weaned pigs

F. Correa [a], D. Luise [a], G. Palladino [b], D. Scicchitano [b], P. Brigidi [c], P.L. Martelli [b], G. Babbi [b], S. Turroni [b], G. Litta [d], M. Candela [b], S. Rampelli [b], P. Trevisi [a,*]

Social stress due to body lesion disrupts homeostasis and affects gut microbiota

Tail-biting at growing/finishing phase

frontiers in Veterinary Science

202
0

Association Between Tail-Biting and Intestinal Microbiota Composition in Pigs

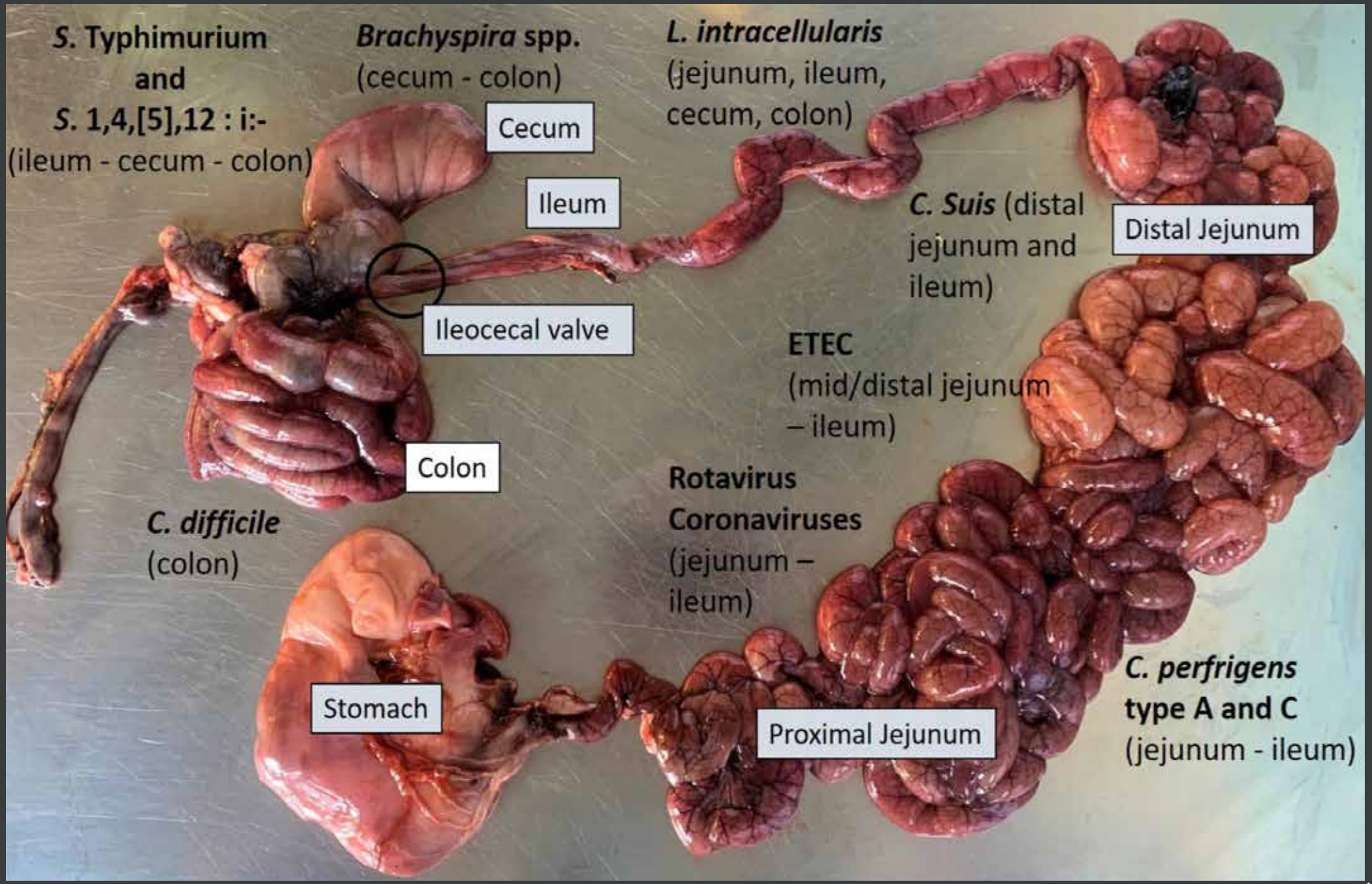
*Nassima Rabhi [1,2], Alexandre Thibodeau [1,2], Jean-Charles Côté [1,2], Nicolas Devillers [3], Benoit Laplante [4], Philippe Fravalo [1,2], Guillaume Larivière-Gauthier [1,2], William P. Thériault [1,2], Luigi Faucitano [3], Guy Beauchamp [1,2] and Sylvain Quessy [1,2]**

Tail biter and bitter pigs: more stressed and altered microbiota composition.

The challenge of **enteric diseases**

Nadis Animal Health Skills

Takeuti et al. (2013)



HQP23 LATAM

Luppi et al. (2023)

PLOS ONE

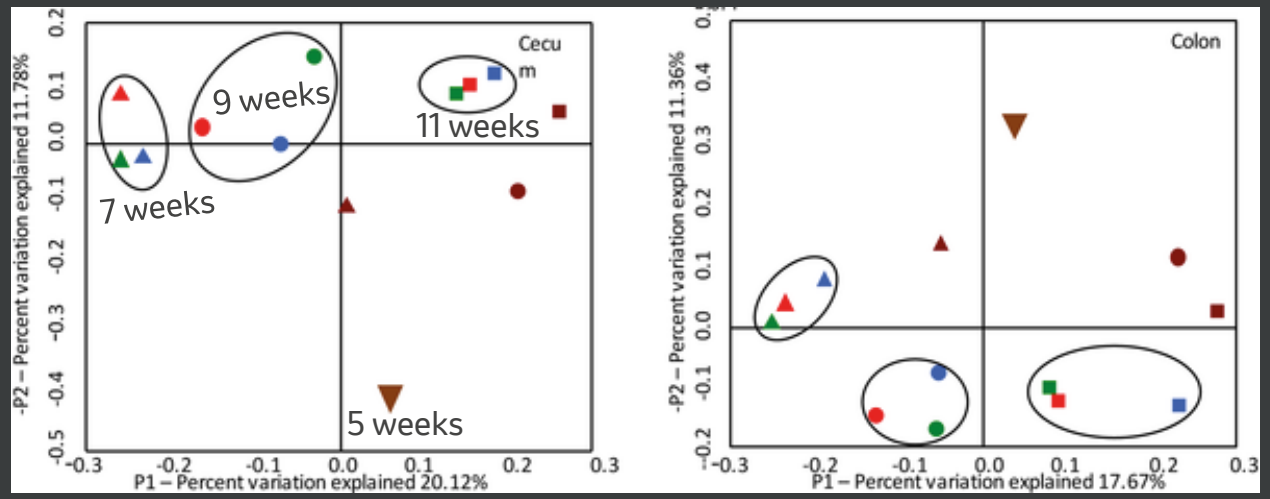
OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

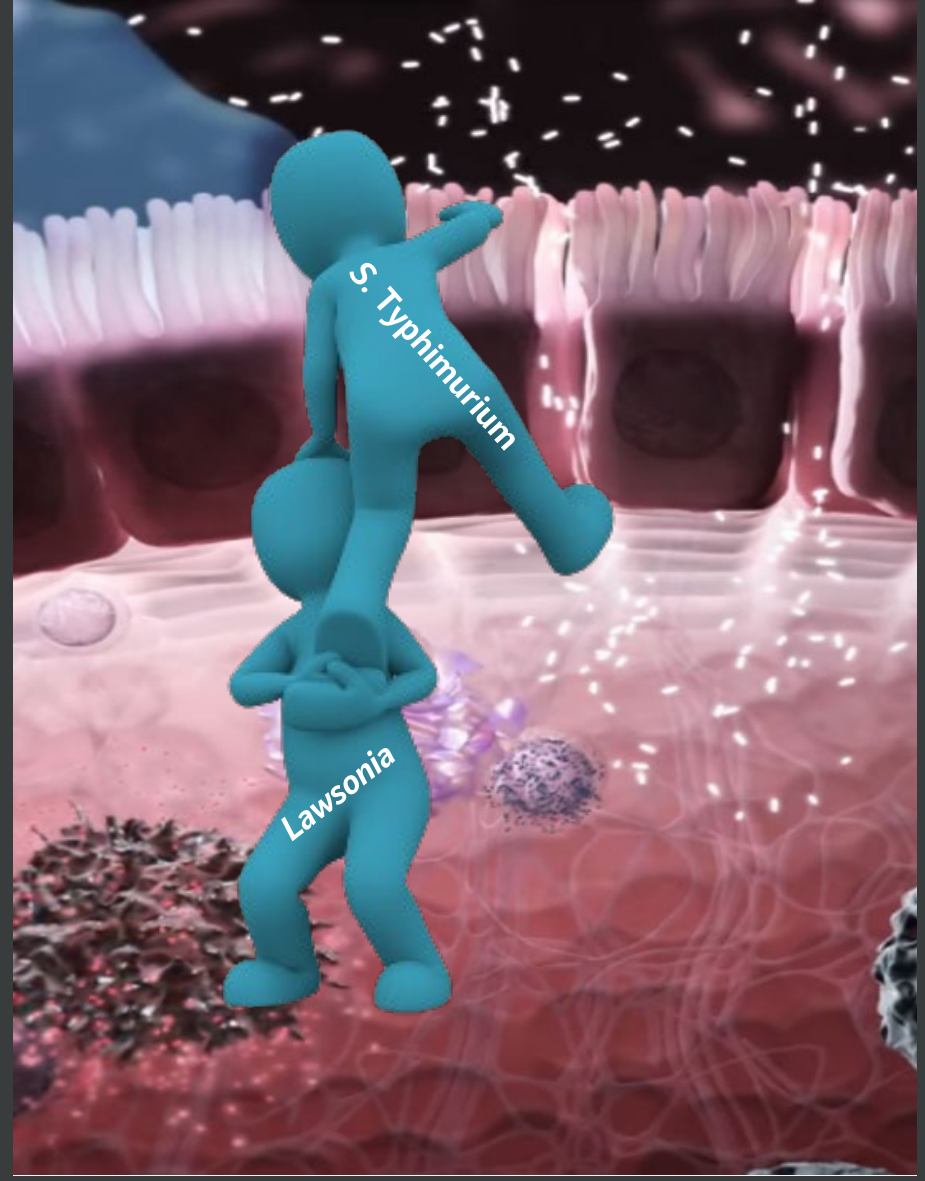
Changes in the Porcine Intestinal Microbiome in Response to Infection with *Salmonella enterica* and *Lawsonia intracellularis*

Klaudyna A. Borewicz, Hyeun Bum Kim, Randall S. Singer, Connie J. Gebhart, Srinand Sreevatsan, Timothy Johnson, Richard E. Isaacson

Published: October 13, 2015 • https://doi.org/10.1371/journal.pone.0139106



● No challenged (n=7); ● *S. enterica* serovar Typhimurium (n=7);
● *Lawsonia intracellularis* (n=7); ● Both pathogens (n=7).



HQP23 LATAM

Similar colonic and cecal microbiome composition.

High Quality Pork Seminars

MSD Animal Health

Veterinary Microbiology 231 (2019) 76–79

Contents lists available at ScienceDirect

Veterinary Microbiology

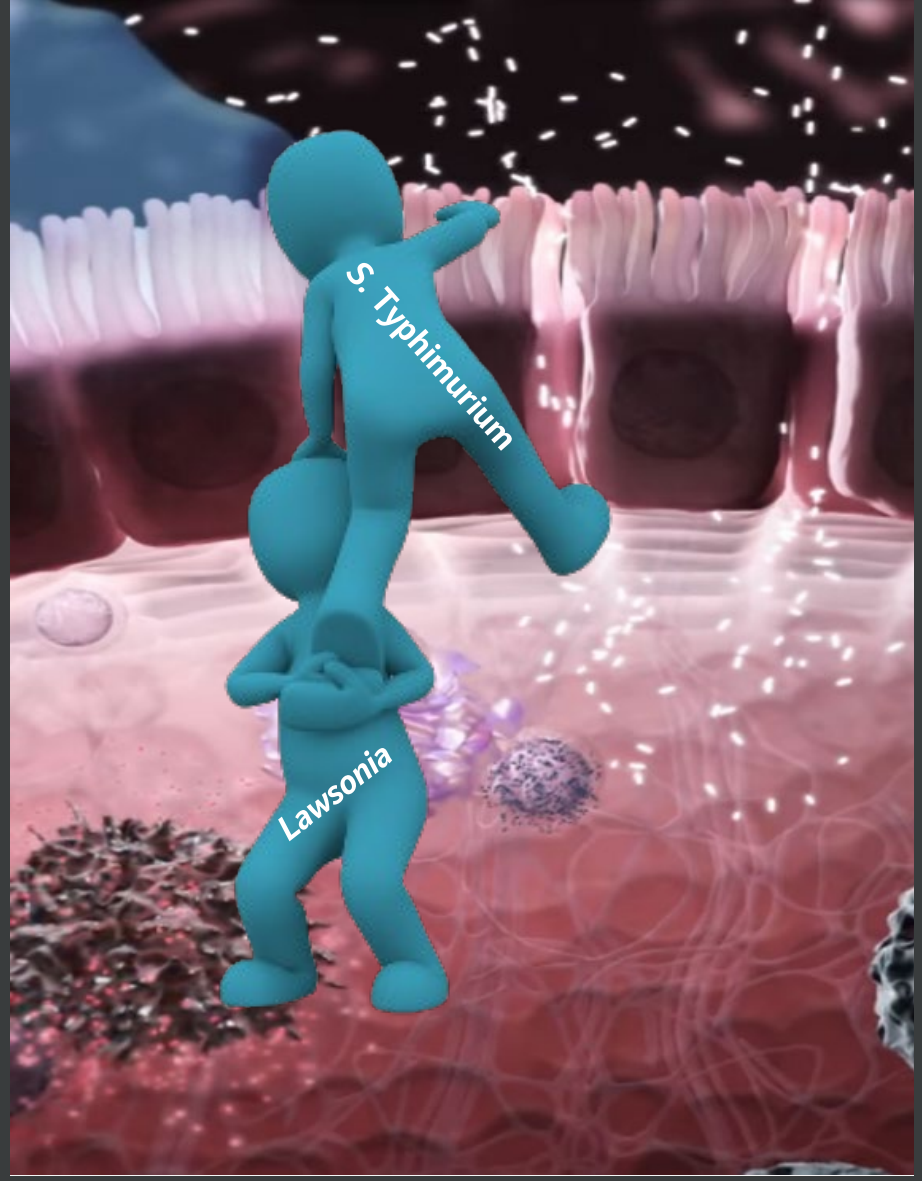
journal homepage: www.elsevier.com/locate/vetmic

The effects of *Lawsonia intracellularis*, *Salmonella enterica* serovar Typhimurium and co-infection on IL-8 and TNFα expression in IPEC-J2 cells

Fernando L. Leite[a], Erika Vasquez[b], Connie J. Gebhart[a], Richard E. Isaacson[a,*]

L. intracellularis leads to increased expression of IL-8 and TNF-α and has an additive effect on their expression in co-infection.

One mechanism by which *L. intracellularis* favors *S.* Typhimurium infection.



HQP23 LATAM

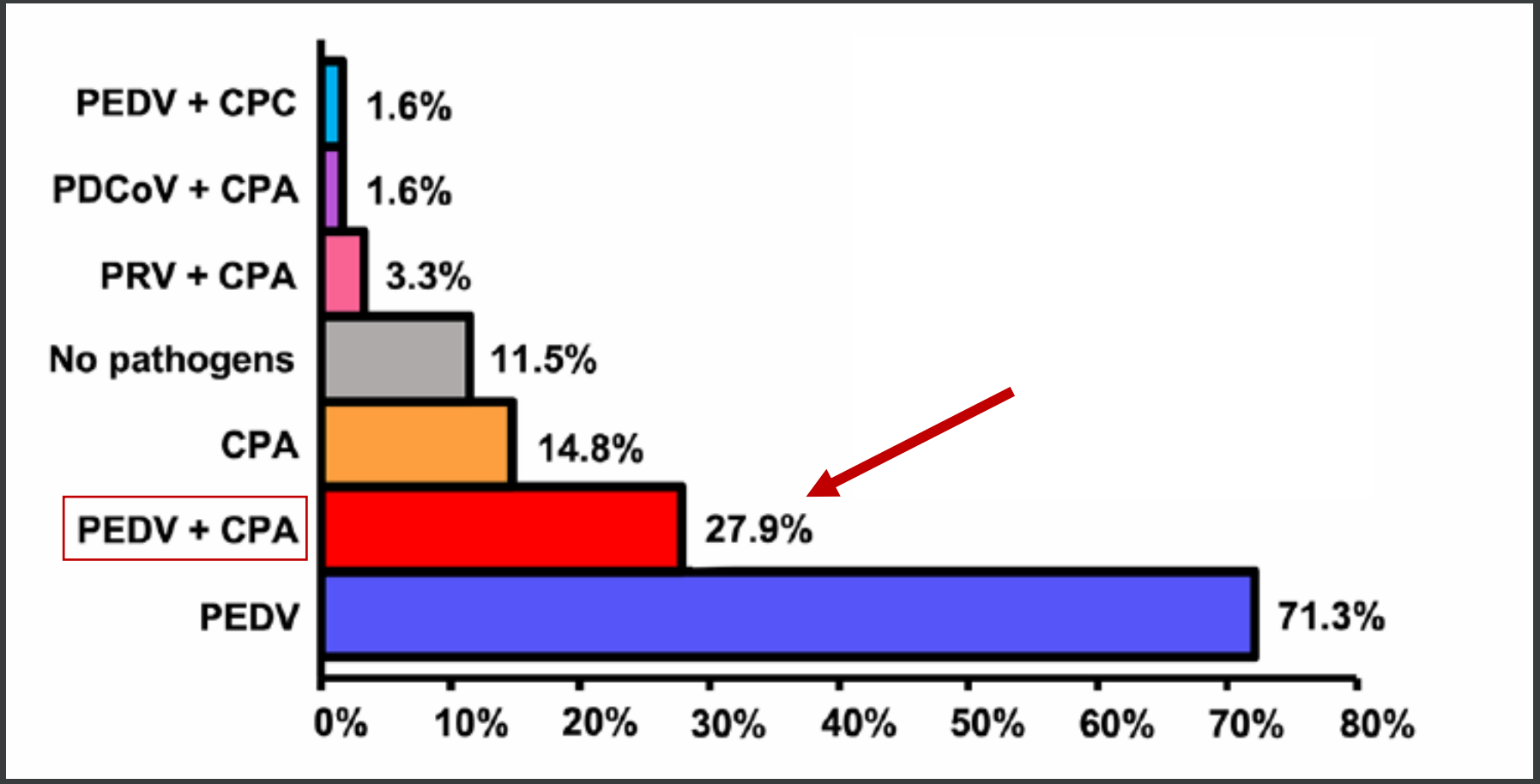
High Quality Pork Seminars

MSD Animal Health

Coinfection with **PEDv** and ***Clostridium perfringens*** type A **enhances** disease severity in weaned pigs

HQP23 LATAM

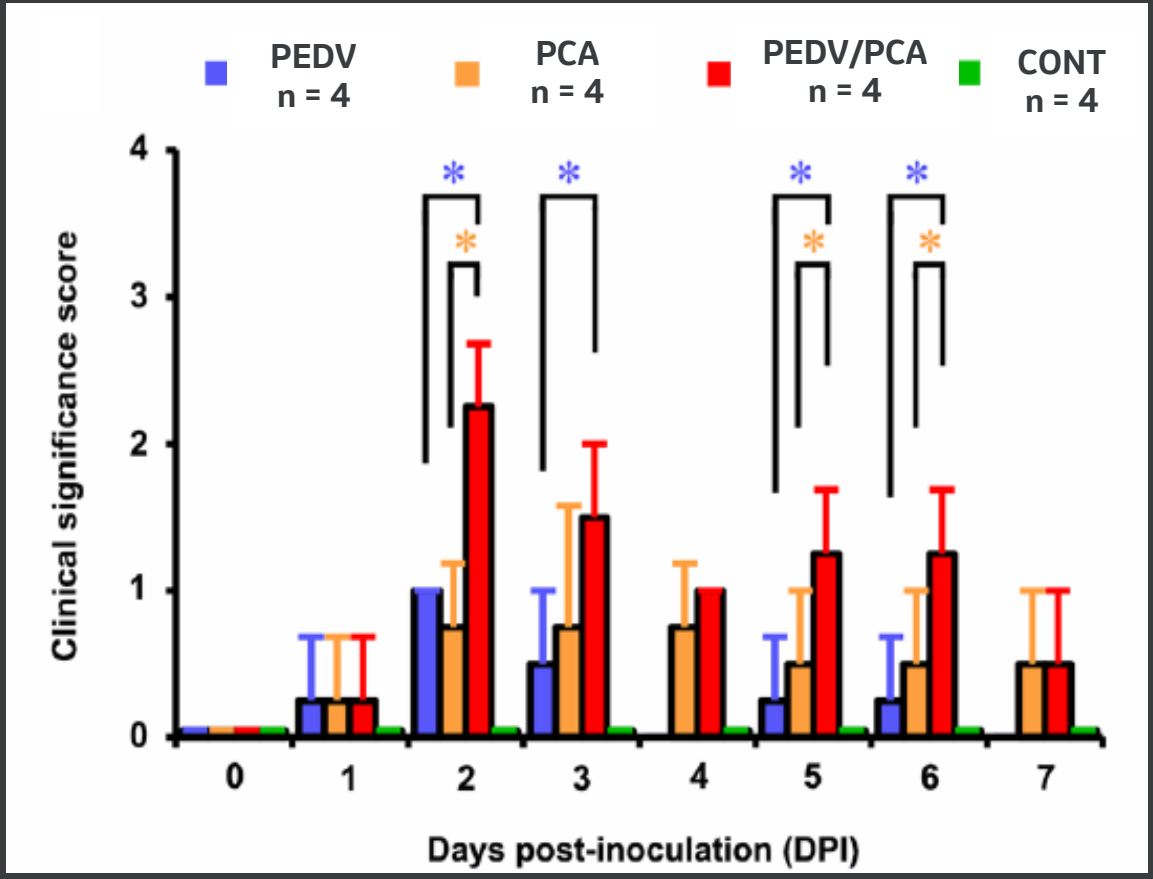
- 61 farms in South Korea;
- Fecal samples (*n* = 203) of affected piglets (2–4 weeks of age);
- Collected from Jan 2021 - Jan 2022.



Lee et al. (2023)

Coinfection with **PEDv** and ***Clostridium perfringens*** type A **enhances** disease severity in weaned pigs

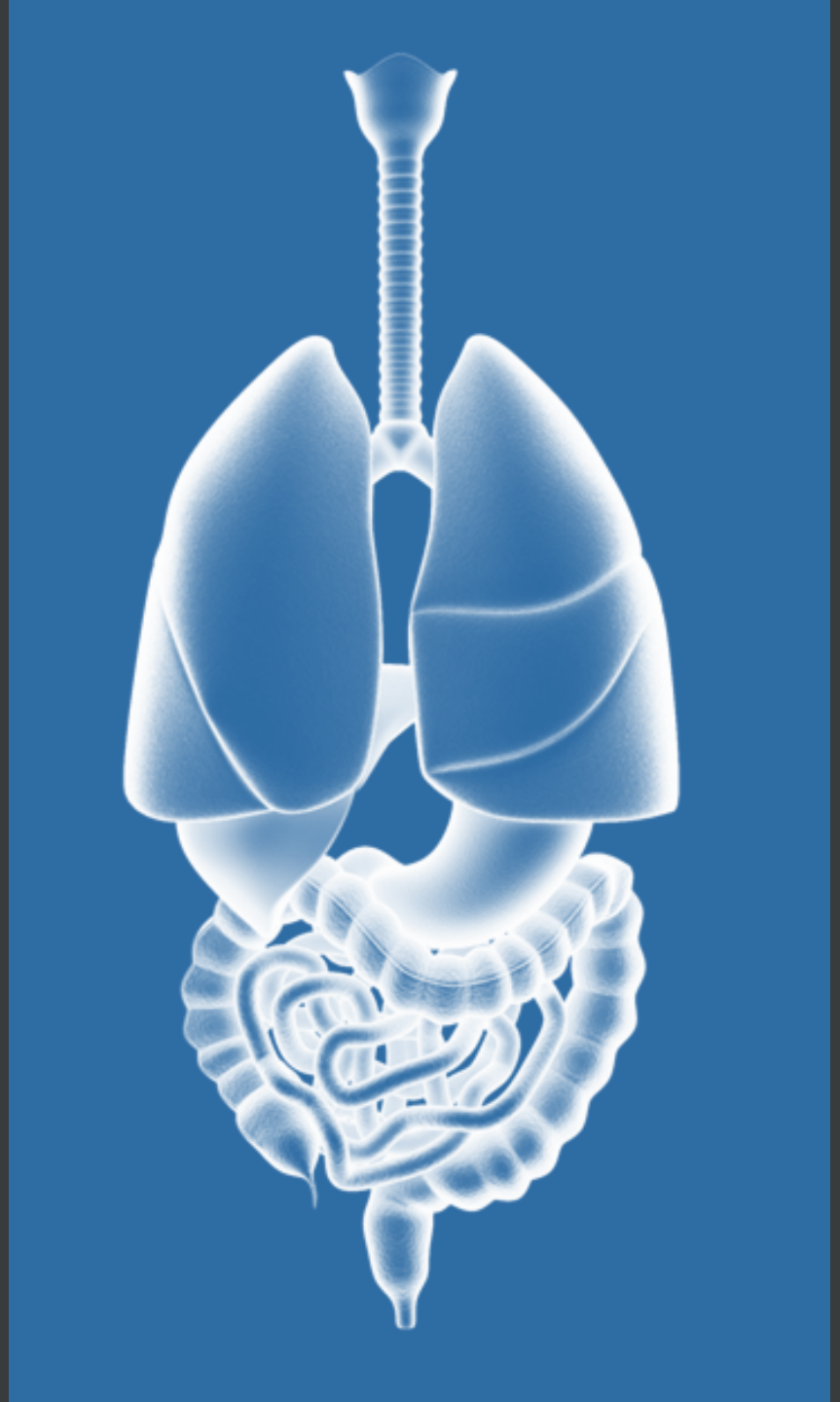
HQP23 LATAM



Inoculation: 21 days of age
Evaluation: 7 days

Lee et al. (2023)

HQP23
LATAM



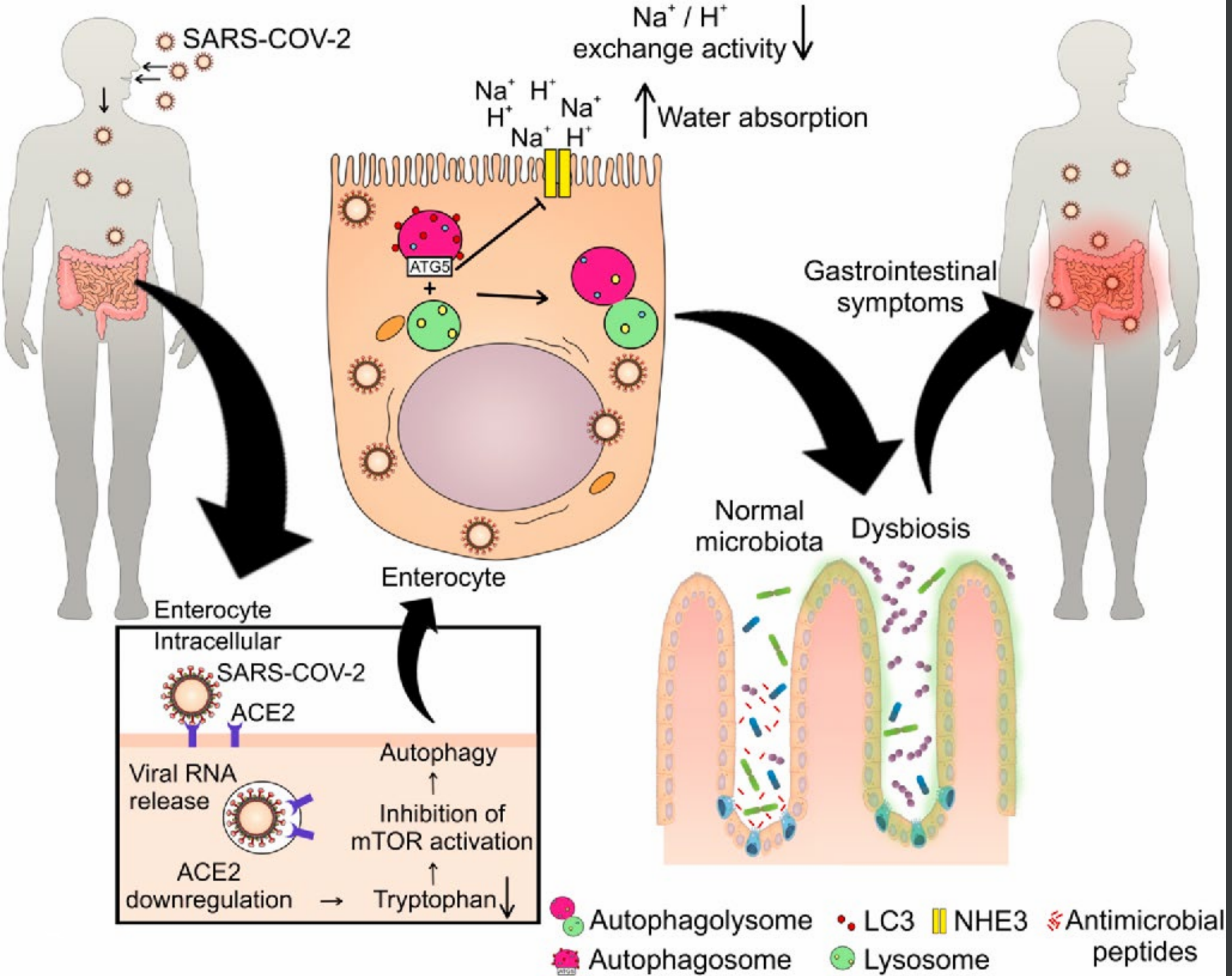
Cross talk between the lung and the gut

High Quality Pork Seminars

MSD Animal Health

HQP23
LATAM

COVID-19 and intestinal dysbiosis



Oliveira et al. (2020)

AMERICAN SOCIETY FOR MICROBIOLOGY | mSystems®

RESEARCH ARTICLE

Dysbiosis of Gut Microbiota and Intestinal Barrier Dysfunction in Pigs with Pulmonary Inflammation Induced by *Mycoplasma hyorhinis* Infection

Yingying Zhang,[a] Yuan Gan,[b] Jia Wang,[b] Zhixin Feng,[b] Zhaoxin Zhong,[c] Hongduo Bao,[a] Qiyan Xiong,[b] Ran Wang[a]

Gut microbial dysbiosis ↑
(Opportunistic pathogens)

Immunomodulatory proteins
(Intestinal proteomic alterations ↑)

Barrier function
(D-lactate and Dao ↓)

n = 12
Day 42

Bama miniature pigs

20 mL IP on day 19;
10 mL IV on day 20;
10 mL IN on day 21.
Total dose: 1 × 109 CCU/pig.

Research Article

Received: 1 September 2022 Revised: 25 April 2023 Accepted article published: 2 May 2023 Published online in Wiley Online Library:

(wileyonlinelibrary.com) DOI 10.1002/jsfa.12690

Perturbations of gut microbiome and metabolome of pigs infected with *Mycoplasma hyorhinis*

Yingying Zhang,[a] Yuan Gan,[b] Hongduo Bao[a*] and Ran Wang[a*]

Gut microbial dysbiosis ↑
(Opportunistic pathogens)

Gut metabolites

Small intestine: Lipid metabolism and amino acid metabolites ↑

Large intestine: Lipid metabolism and amino acid metabolites ↓

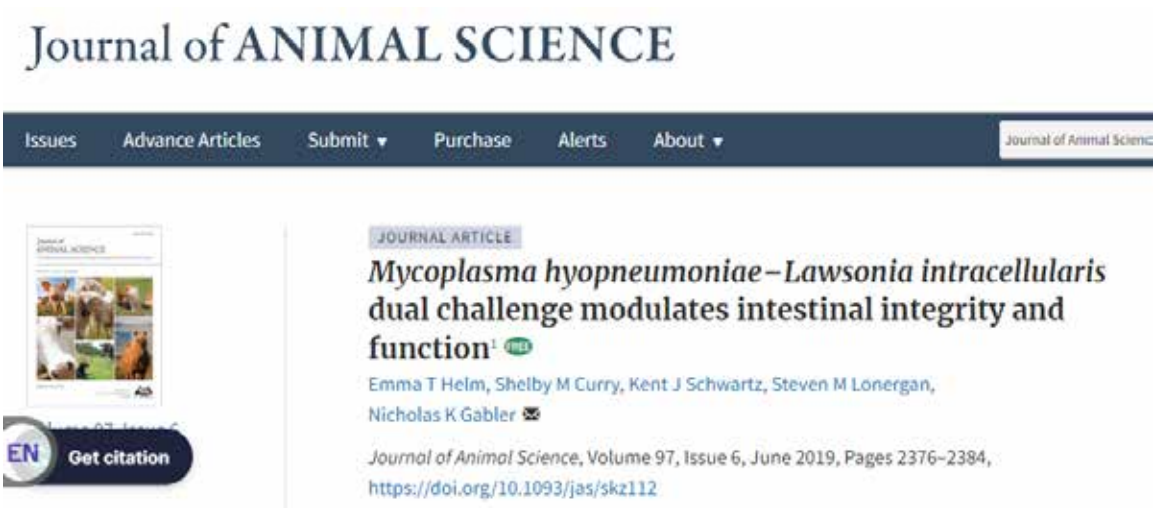
n = 10
Day 22

HIGH QUALITY PORK SEMINARS

Zhang et al. (2022)

MSD Animal Health

Zhang et al. (2023)



MhLI, n = 12 pigs
Control, n = 12 pigs

Mh = 10 mL inoculum (1×10^5 color-changing units/mL) via intratracheal gavage.

LI = 40 mL inoculum (2 mL gut homogenate, with 2×10^7 LI) intragastrically.

↓ performance: ADG (38%, $P < 0.001$), ADFI (25%, $P < 0.001$), and G:F (19%, $P = 0.012$).

↑ ileal glucose transport (30%, $P = 0.05$) and ↓ sucrase activity (30%, $P = 0.049$).

Did NOT affect ileum morphology or transepithelial resistance ($P > 0.10$).

↑ translocation of *S.* Typhimurium in the colon.**

Helm et al. (2019)


HQP23
LATAM
What challenges for intestinal health can we face in the coming years?
High Quality Pork
MSD
Animal Health

HQP23
LATAM

We still engaged in the progressive reduction of antibiotic use

But there is still a long way to go.

HQP23
LATAM

From post-weaning diarrhea alternative solution to the banning challenge

- June 2022: the use of pharmacological levels of ZnO in weaned piglet feed was banned in the EU.
- Only 150 ppm is allowed.

High Quality Pork

MSD
Animal Health

HQP23 LATAM

Why ZnO need to be replaced?

Toxicity effects
In case of too high or too prolonged administration

Environment
Pollution from zinc-rich manure application on fields

Antibiotics
Acceleration of antibiotic resistance genes spread

Heavy metals
Increase of heavy metal tolerance genes spread

Microbiota
Modification of bacterial population composition

Bonetti et al. (2021)

What questions does the ZnO ban bring up?

HQP23 LATAM

- What is the economic impact?
- Will it increase the need for antibiotics?
- What are the feed alternatives?
- What needs to change on the farm without ZnO?
- How is America looking at this? Do we have time me to prepare for it?

High Quality Pork

MSD Animal Health

How to overcome the pig intestinal challenges?

HQP23
LATAM

The holistic approach era

HIGH QUALITY PORK

MSD Animal Health

Work with prevention

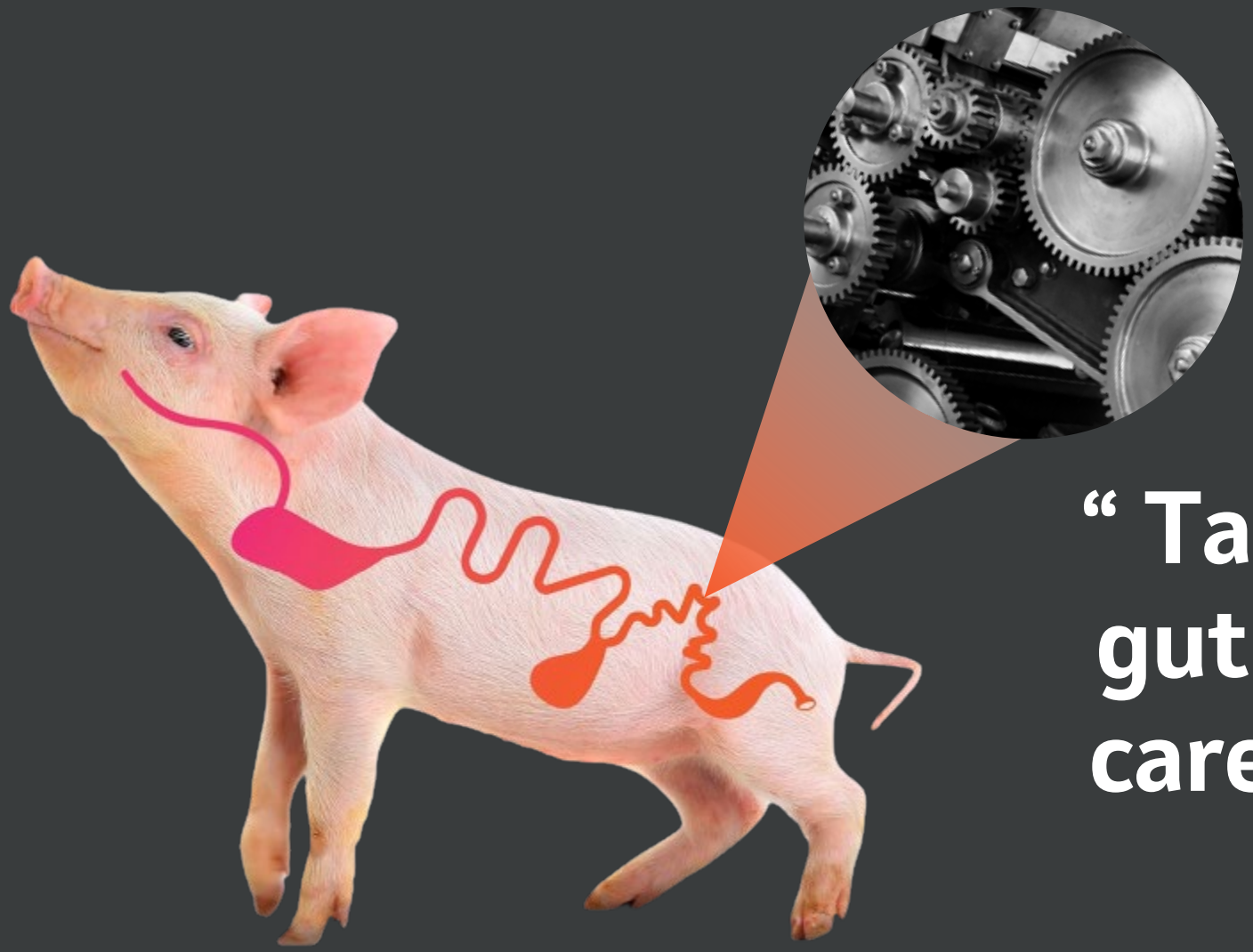
HQP23 LATAM

- Ensure a good piglet's microbiota colonization of the piglets;
- Animal welfare is also a way forward;
- Implementation of a **health program** to reduce the risk of future outbreaks and the antimicrobials and ZnO usage.

Farmers, nutritionists, veterinarians.

MSD Animal Health

HQP23
LATAM



“ Take care of the piglets gut first, and it will take care of everything else.”

HQP23 LATAM

Thank you!

Jéssica Barbosa
University of Saskatchewan, Canada
eyz350@usask.ca

High Quality Pork Seminars

MSD Animal Health