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FACULTY OF VETERINARY MEDICINE
accredited by EAEVE

WHY CLASSICAL BROILER PRODUCTION YIELDS ANIMALS WITH HIGH SENSITIVITY TO INTESTINAL INFLAMMATION AND INFECTION?

Filip Van Immerseel – Livestock Gut Health Team Ghent

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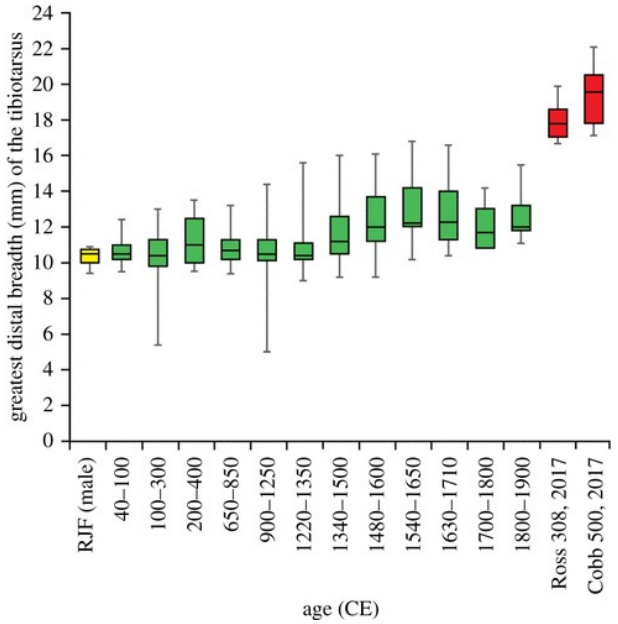
LIGHT
Livestock Gut Health Team Ghent

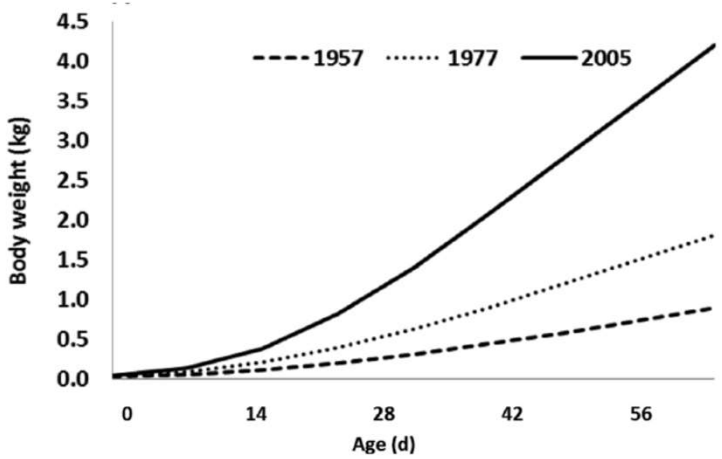
WHAT IS A BROILER? A HUMAN RECONFIGURED ANIMAL

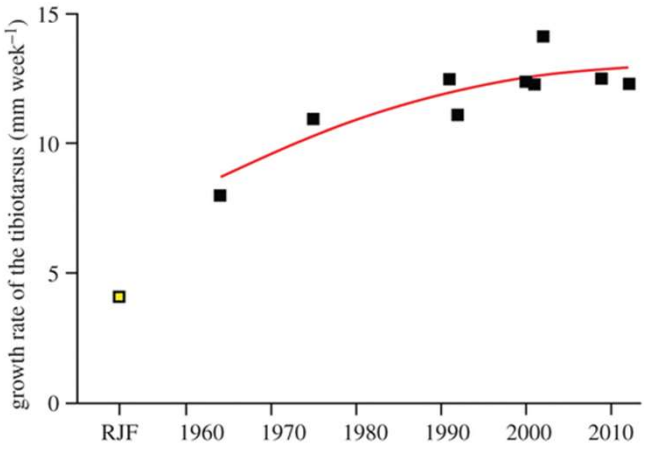


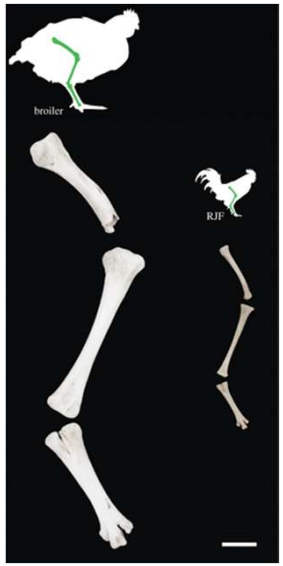
Feed conversion of 1.6

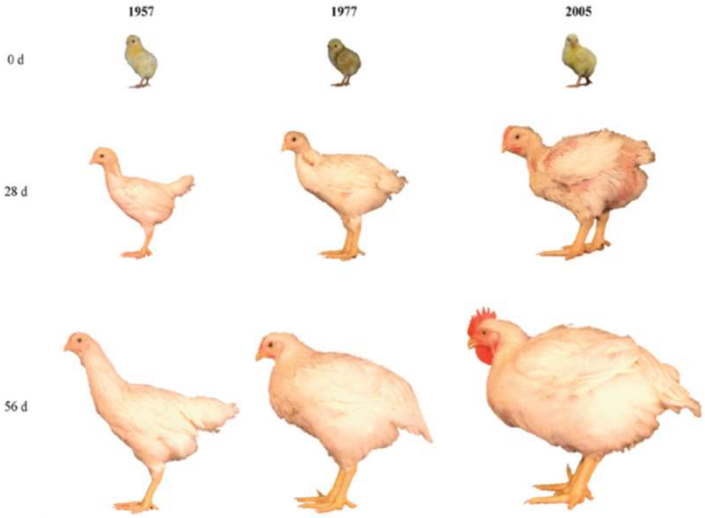
No increase in gut weight or length

Efficiency of digestion and nutrient uptake very high



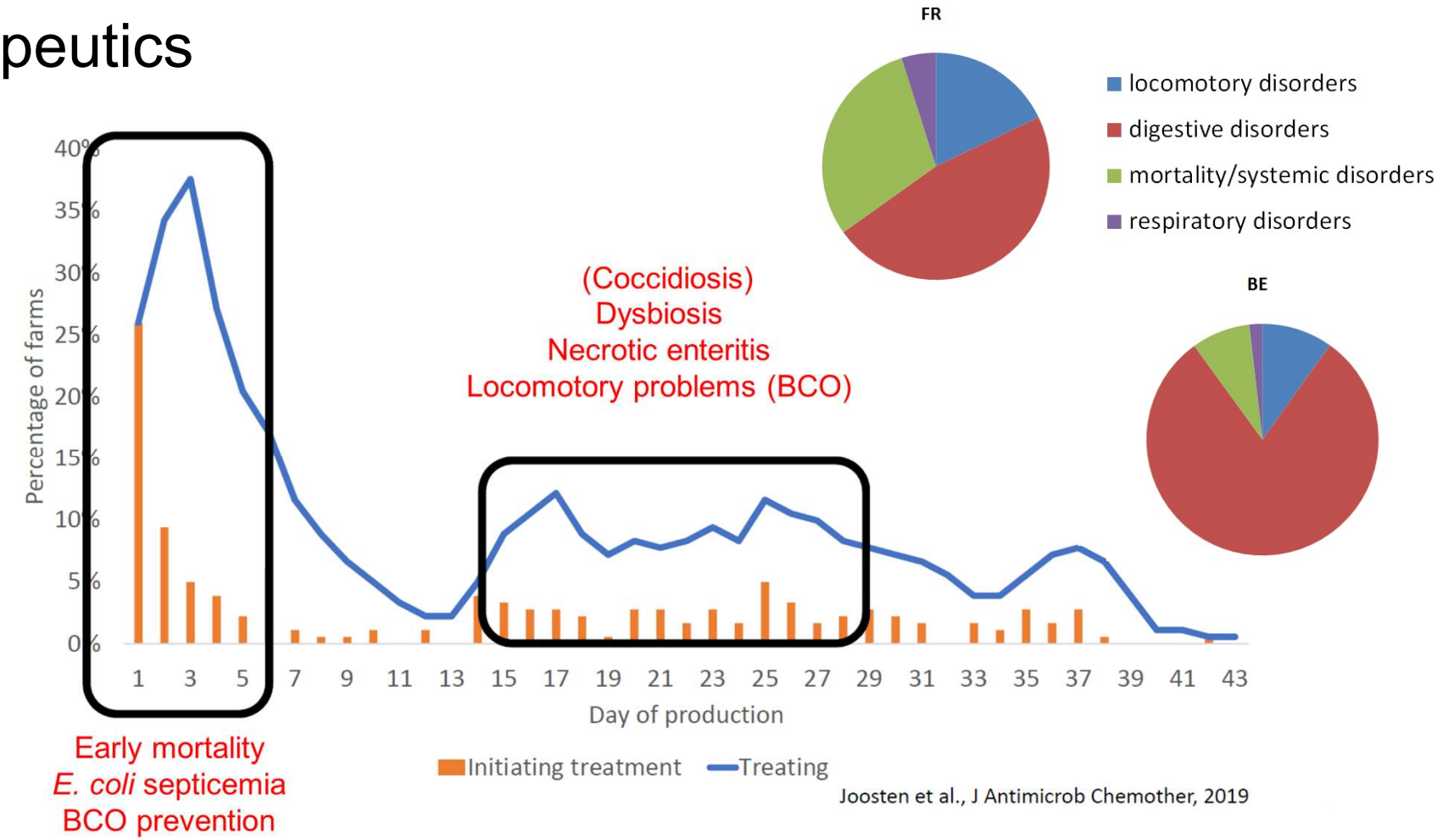






ANTIMICROBIAL USAGE WENT HAND IN HAND WITH PRODUCTION

- Antimicrobial growth promoters
- Therapeutics



Joosten et al., J Antimicrob Chemother, 2019

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NECROTIC ENTERITIS: THE MOST UNCOMMON DISEASE IN THE WORLD FOR HUMANS

Tribal people with low protein diet (so low trypsin in GI tract), Papoua New Guinea (Pigbel)

Feast meals with sweet potatoes (trypsin inhibitors!) and pig meat (containing massive amount of *C. perfringens* type C)

Identical disease (Darmbrand) in previously starved children after world war II

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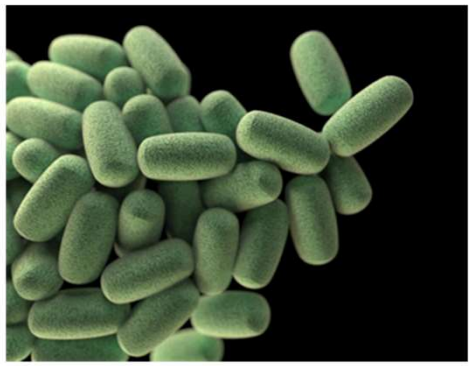
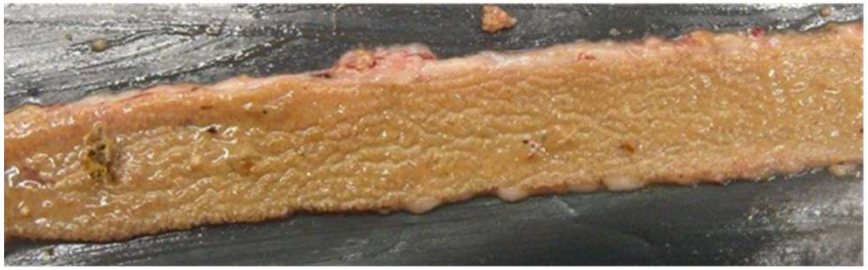
AN EXAMPLE ON THE EFFECTS OF FAST BWG ON DISEASE: NECROTIC ENTERITIS



Predisposing factors

NECROTIC ENTERITIS

Variation in disease severity in a disease model: 40 to 70% of animals develop lesions



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AN EXAMPLE ON THE EFFECTS OF FAST BWG ON DISEASE: NECROTIC ENTERITIS

AVIAN PATHOLOGY
https://doi.org/10.1080/03079457.2019.1614147

Taylor & Francis
Taylor & Francis Group

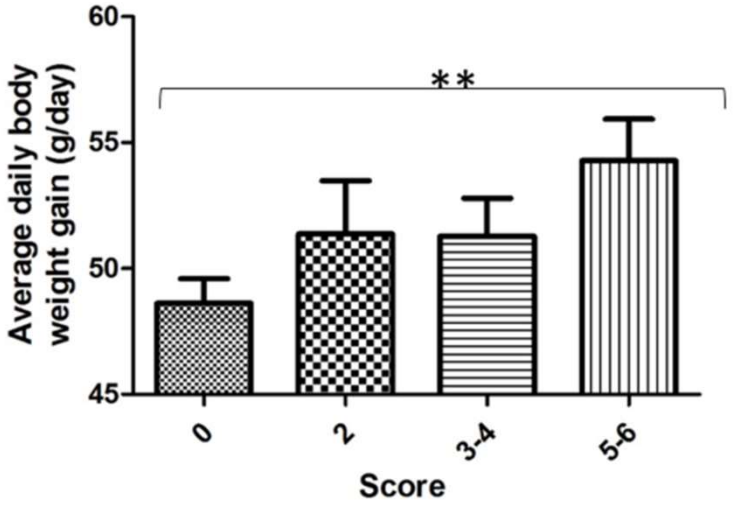
ORIGINAL ARTICLE

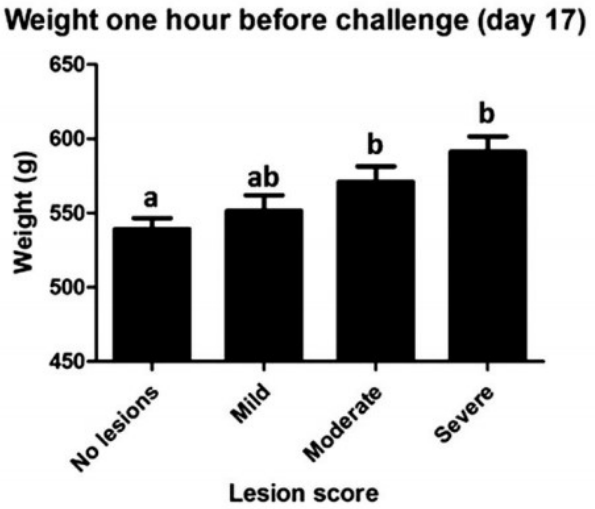
Check for updates

Rapid growth predisposes broilers to necrotic enteritis

E. Dierick[a], O. P. Hirvonen[b], F. Haesebrouck[a], R. Ducatelle[a], F. Van Immerseel[a] and E. Goossens[a]

[a]Department of Pathology, Bacteriology and Avian Diseases, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium; [b]Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, Finland





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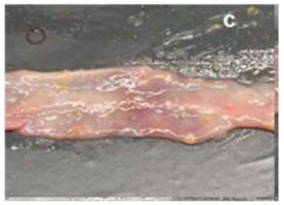
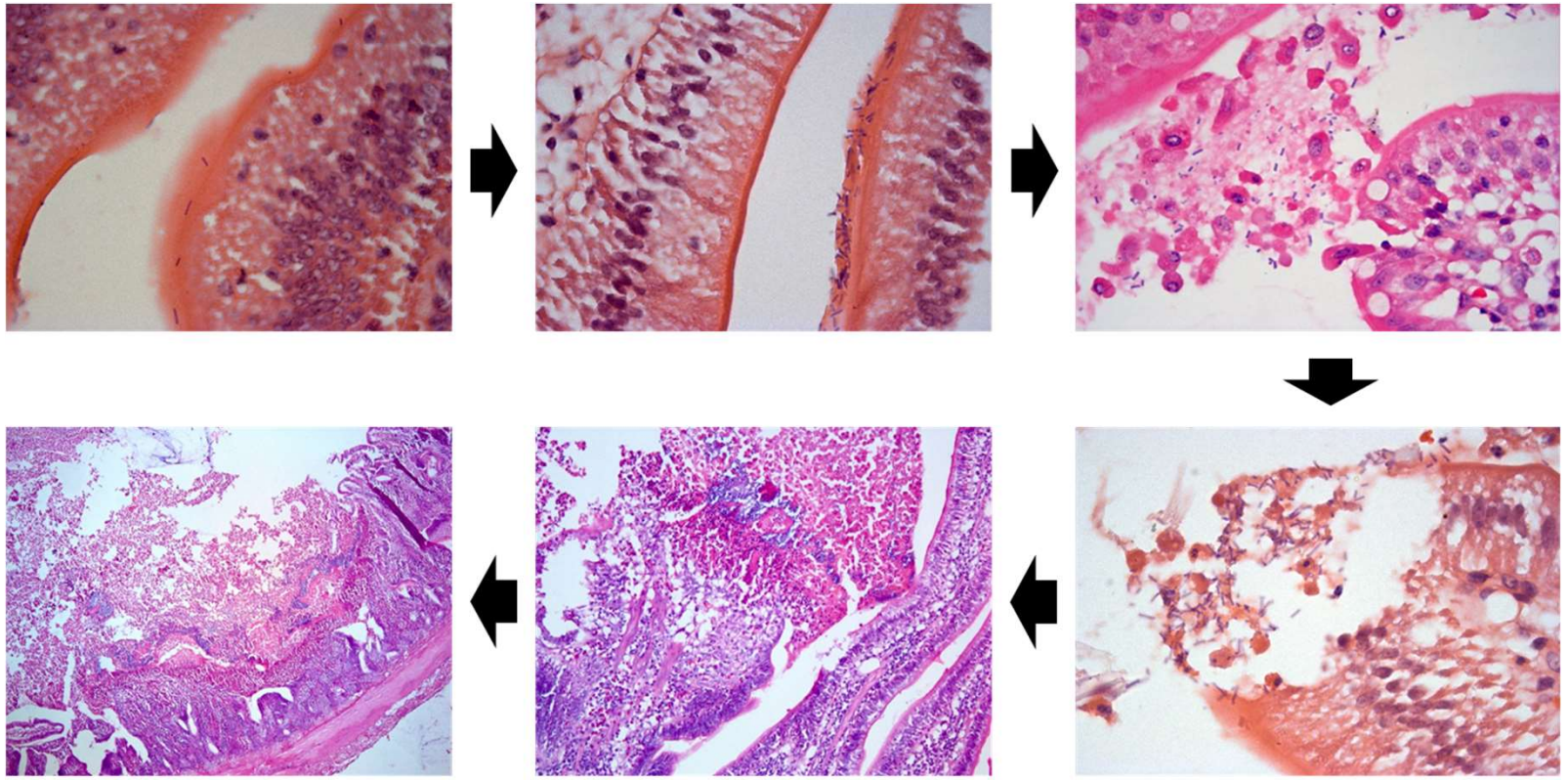


FACTORS INVOLVED IN DISEASE

- Diet and bacterial overgrowth
- Predisposing intestinal damage



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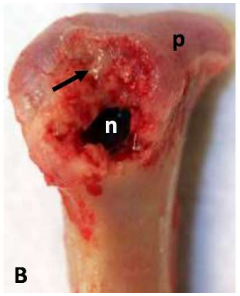
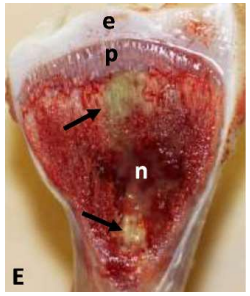
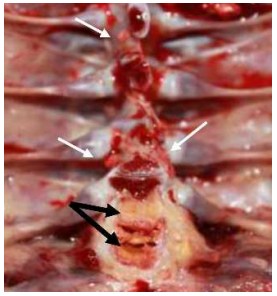
TRANSLOCATION, SEPTICEMIA, BCO, LAMENESS



Femural head necrosis

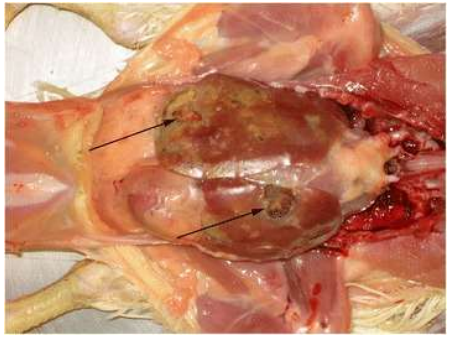


Tibia degeneration



Vertebral osteomyelitis

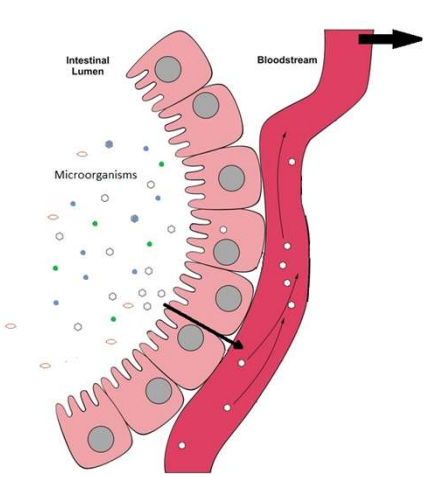
Wideman, 2016



Jung and Rautenschlein, 2014

Pericarditis
Hepatitis

Bacterial isolates are often gut-derived:
Enterococcus cecorum, Escherichia coli, …



Organs
Bones

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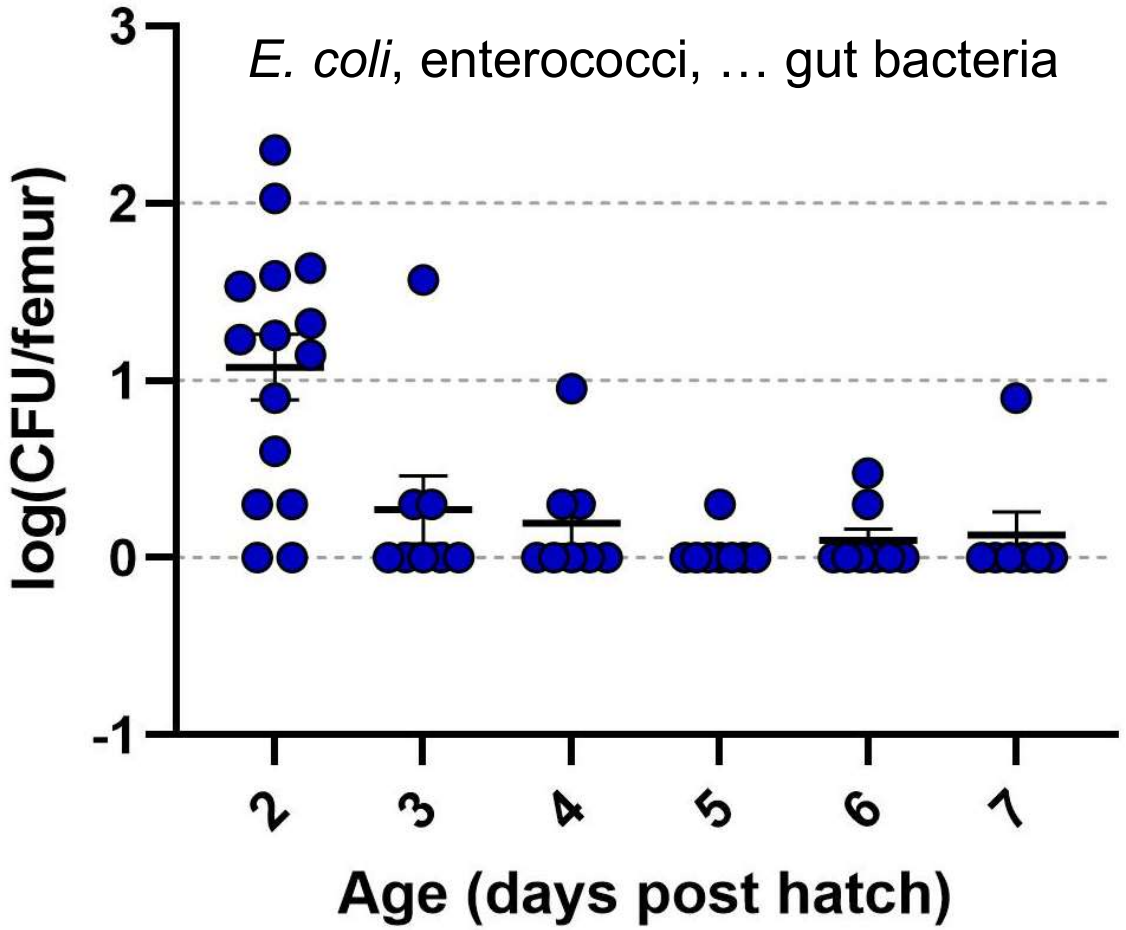
EARLY POST-HATCH GUT HAS HIGH PERMEABILITY



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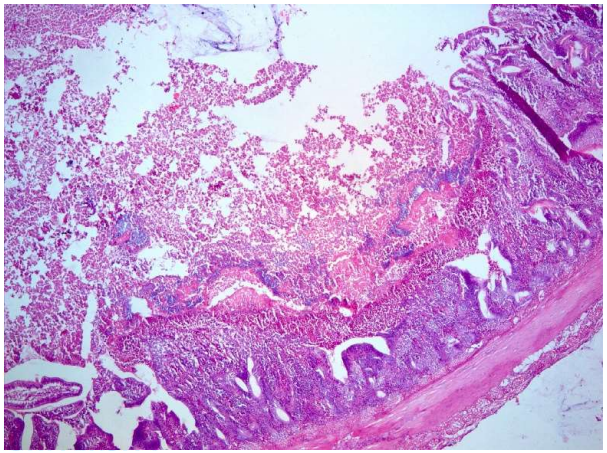
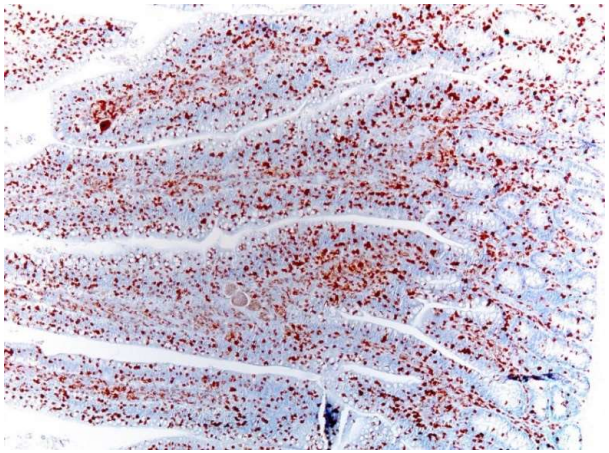
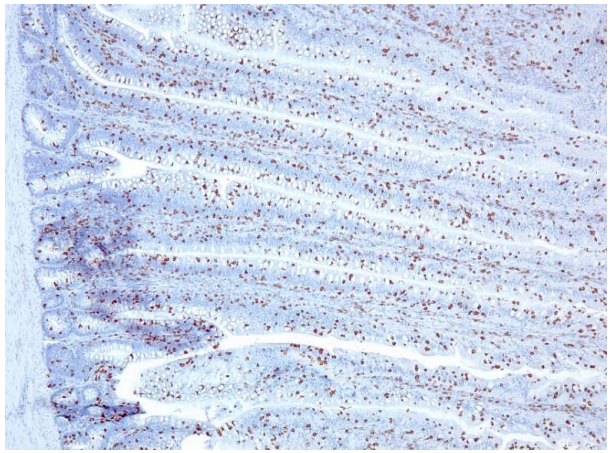
‘DYSBIOSIS’ IN BROILER CHICKENS







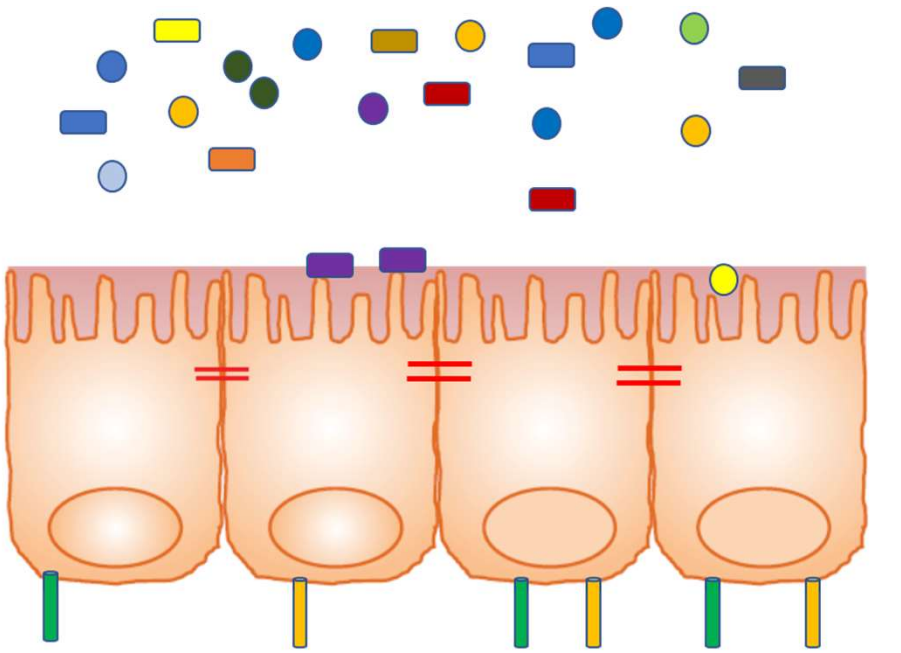
HOMEOSTASIS IN THE GUT

Pathogen recognition receptors

TLRs localized **basolateral**

↓

No activation by commensal microbiota



Toll Like Receptors

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DYSBIOSIS AND INFLAMMATION

Pathogen recognition receptors

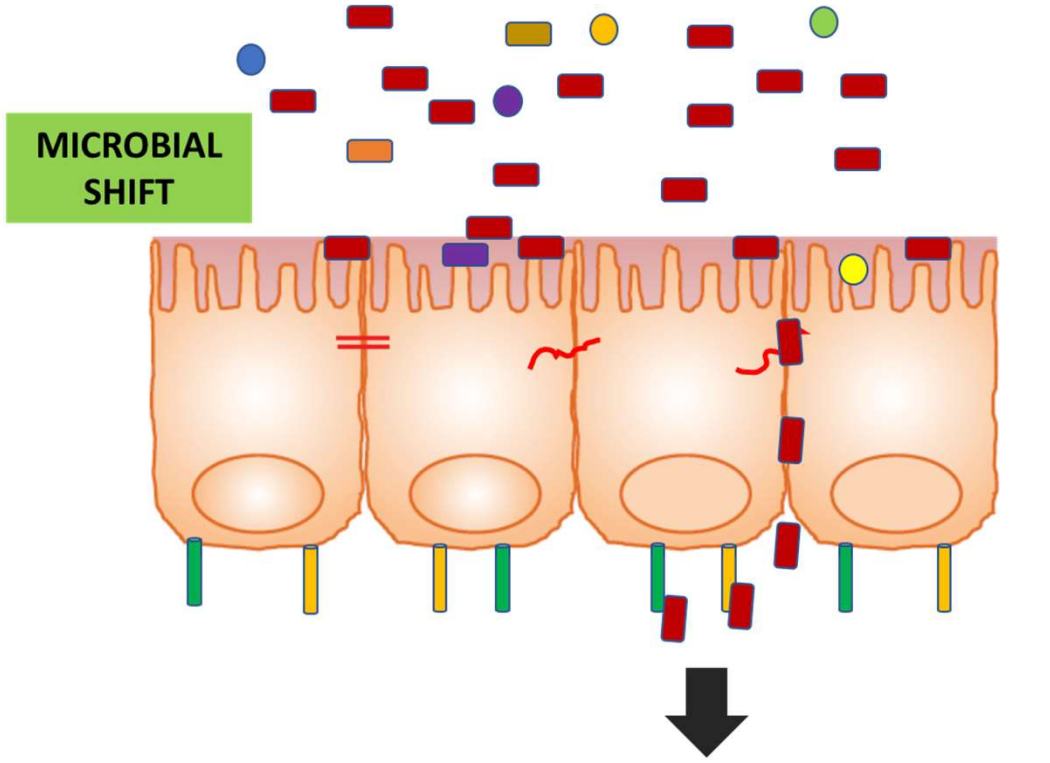
TLRs localized **basolateral**

↓

Activation when there is increased **permeability**

↓

Inflammation cascade



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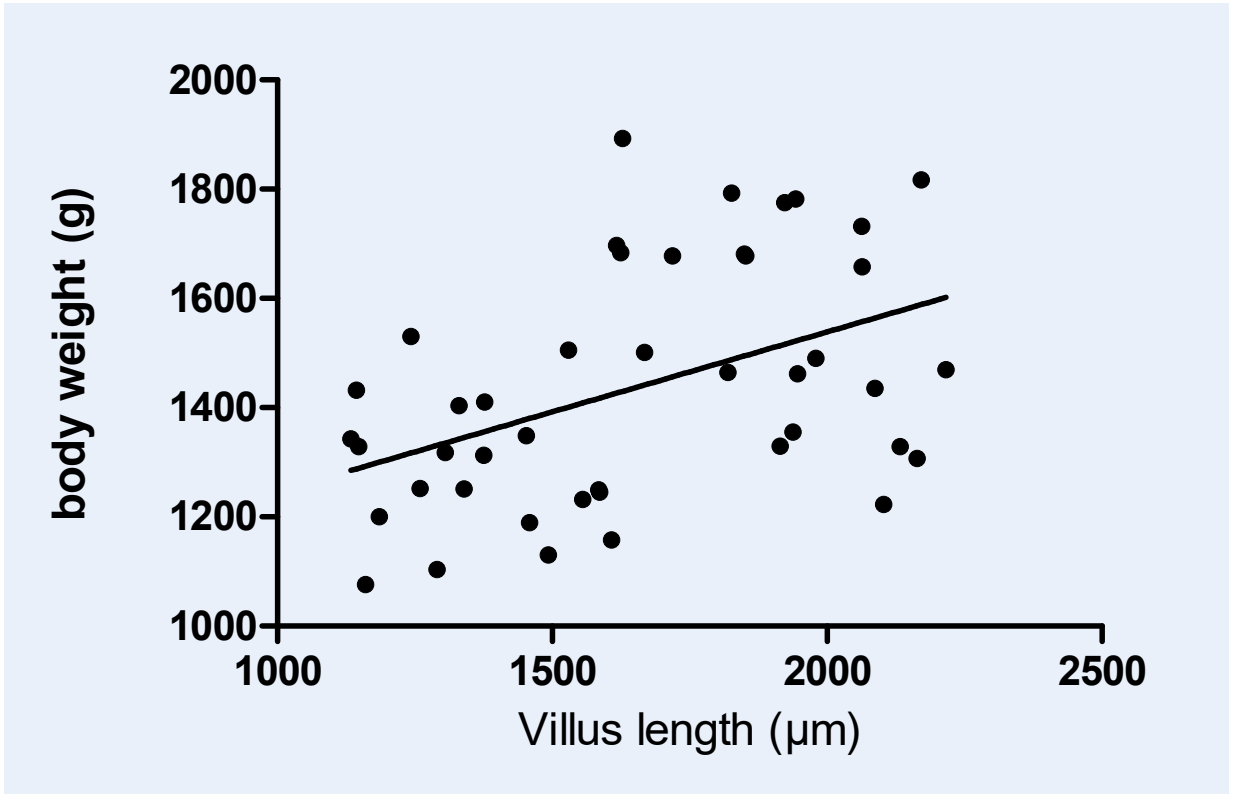

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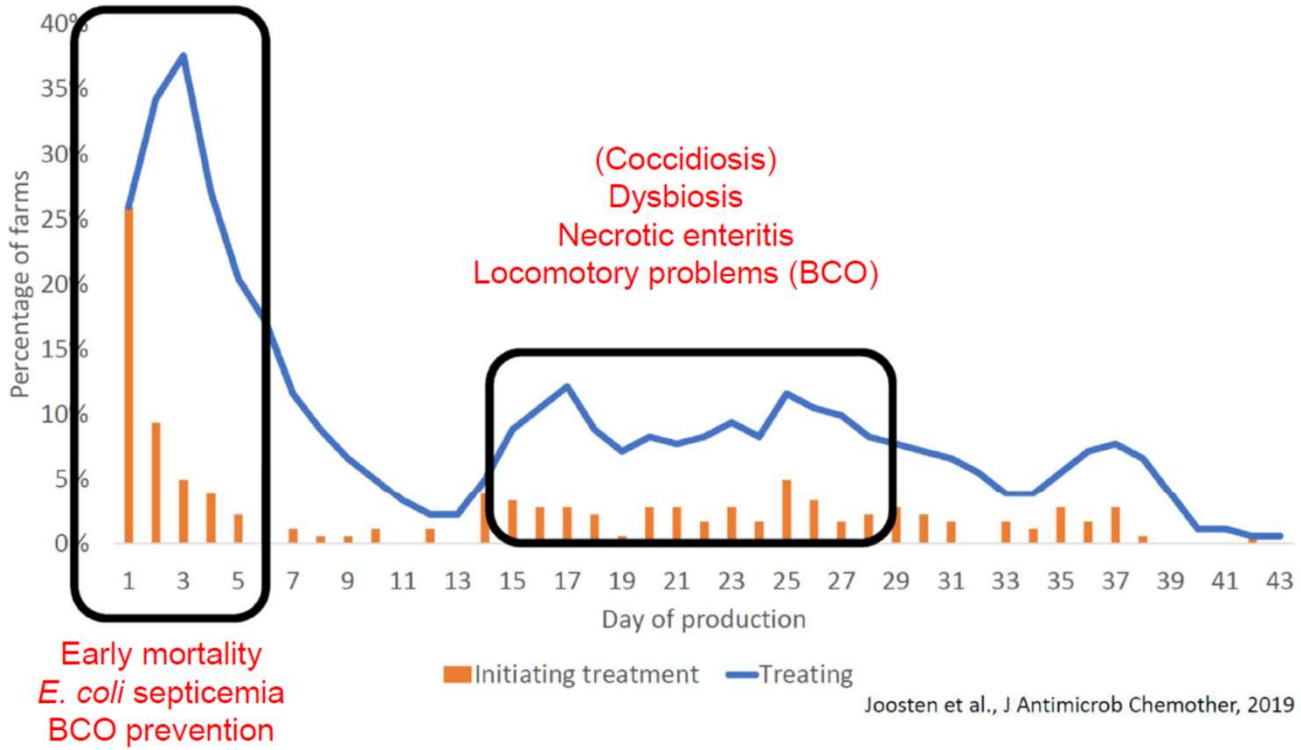
WHY? 1) THE INTESTINAL MICROBIOTA



Lack of microbiota

Immature microbiota

Shift in composition

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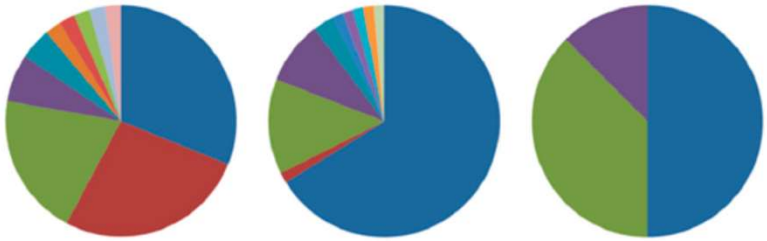
HATCHING CONDITIONS AND IMMATURE MICROBIOTA

- Hatching conditions shape the microbiota composition
- Sterile conditions, initial microbiota though environment, not hen-derived

Fibre-degrading anaerobic consortia present
Diversity increased



Proteobacteria enriched

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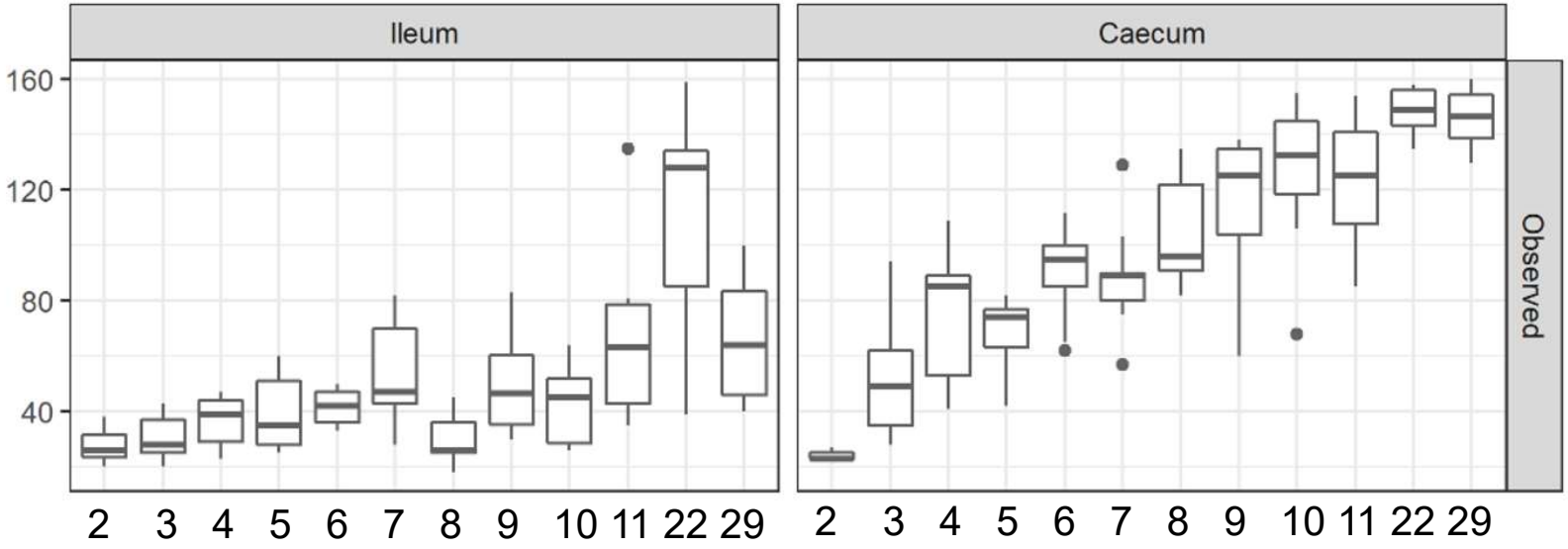
Rychlik, 2020

RICHNESS AND DIVERSITY INCREASE WITH AGE



Strong increase in caecal richness the first 10 days

Difference between intestinal segments

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MICROBIOTA COMPOSITION DEVELOPMENT

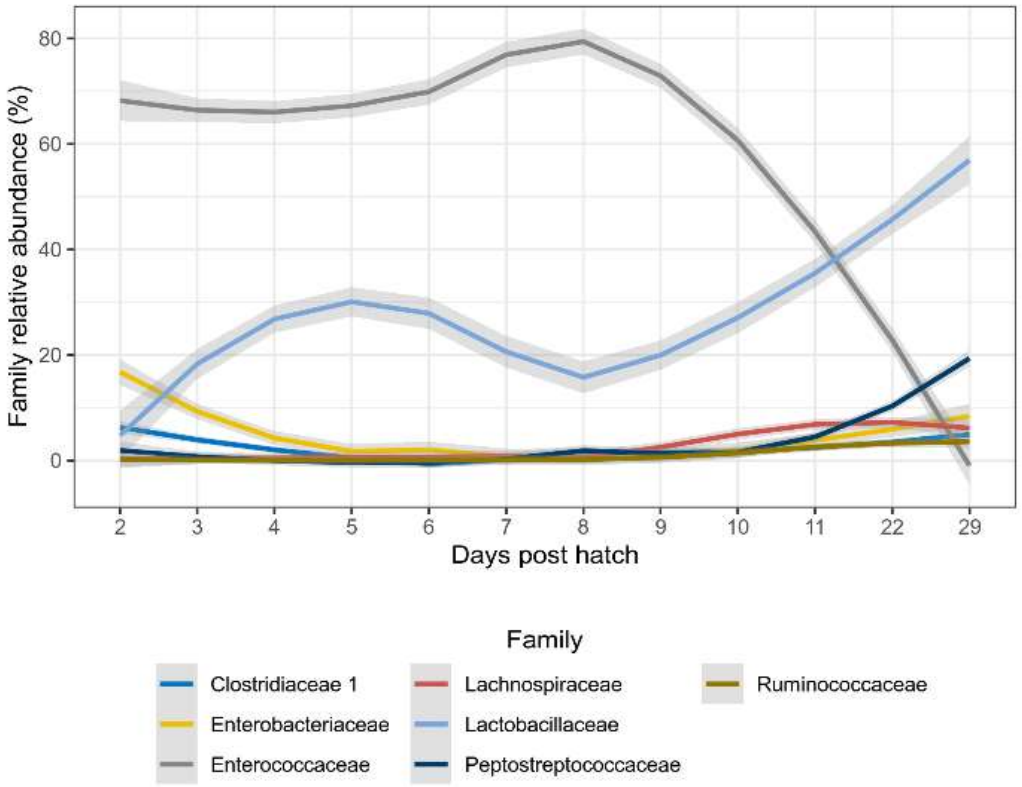
Initial (first days) colonization by facultative anaerobic taxa, eg. *Enterobacteriaceae*, enterococci, lactobacilli

Gradually, in ileum, lactobacilli become dominant

Gradually, in caeca, anaerobic fibre-degrading taxa become dominant and replace the *Enterobacteriaceae*

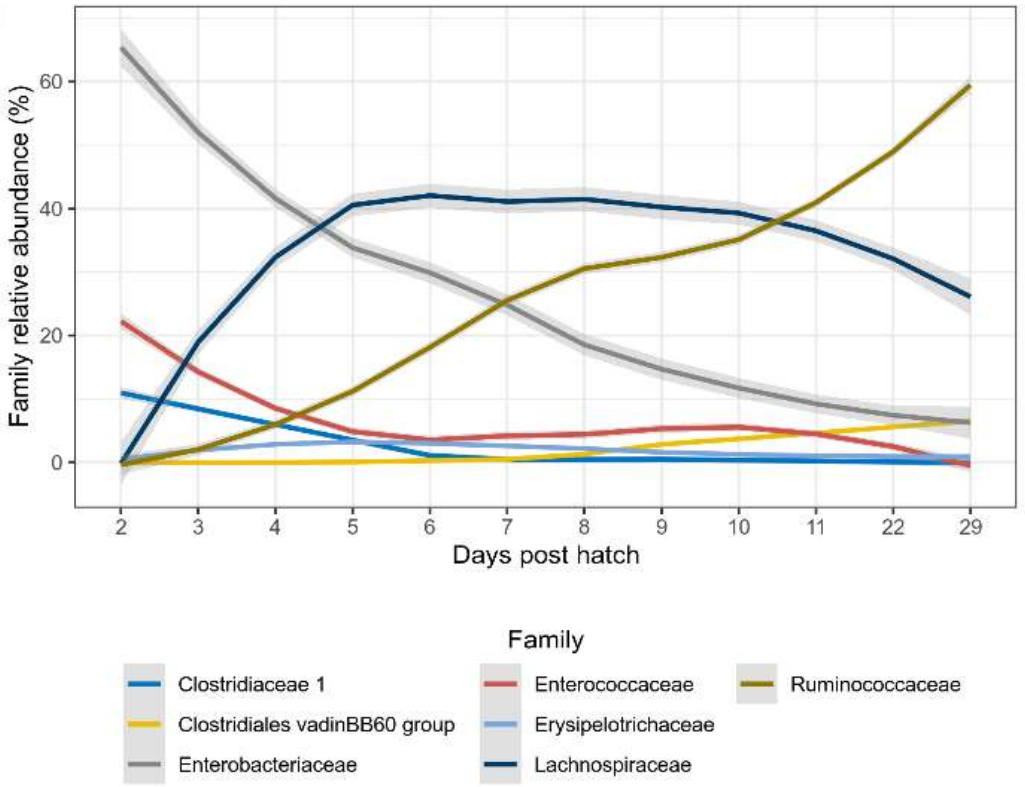
ILEUM

Dominance of lactic acid bacteria



CAECUM

Clear shift towards Ruminococcaceae/Lachnospiraceae



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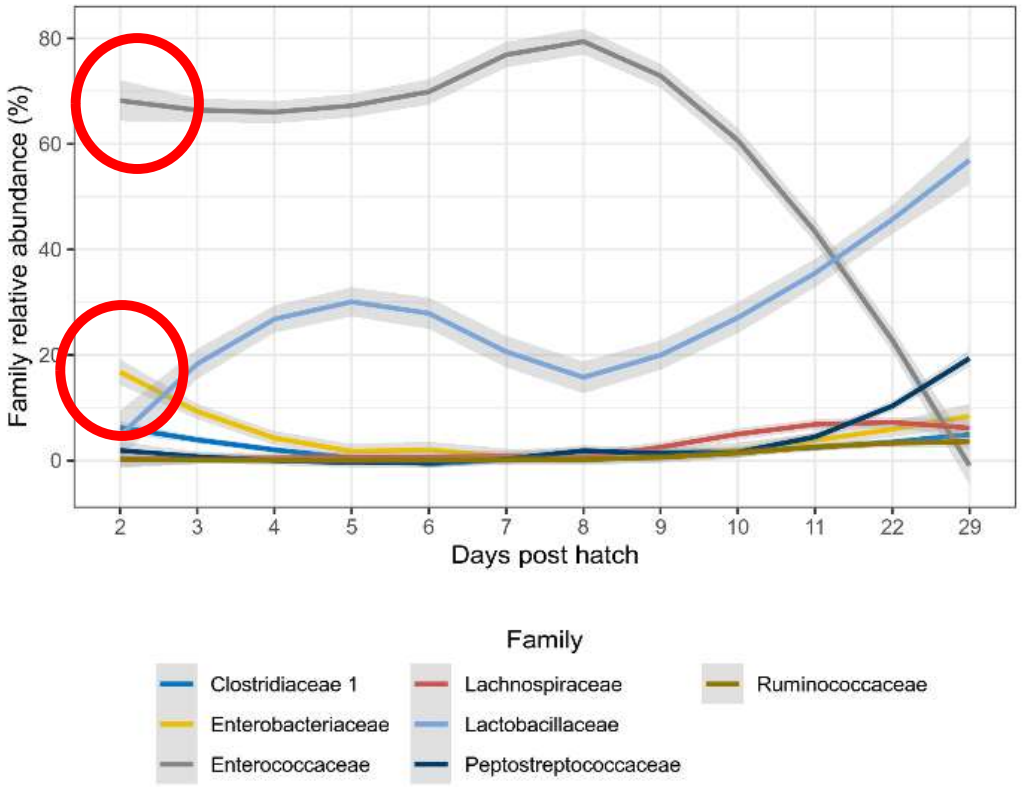
ILEUM

Dominance of lactic acid bacteria



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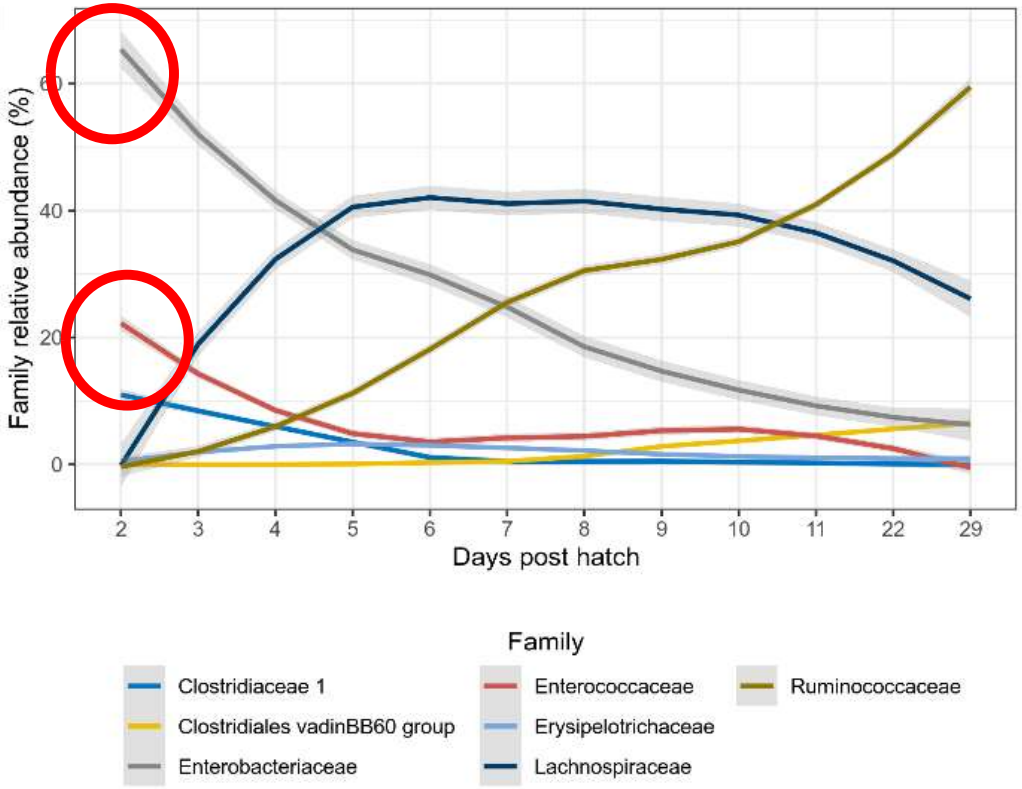

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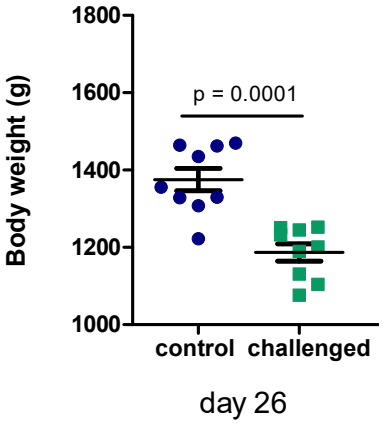

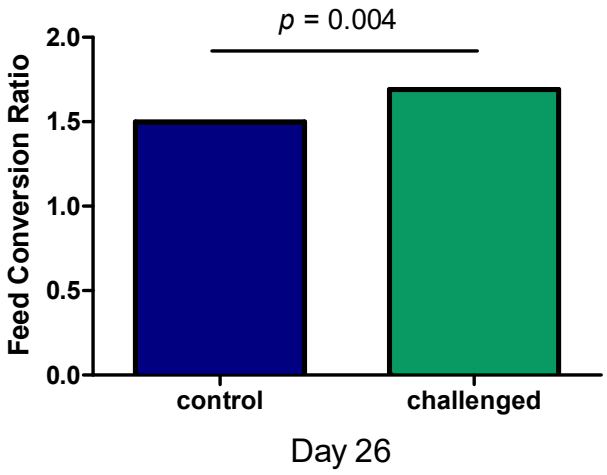

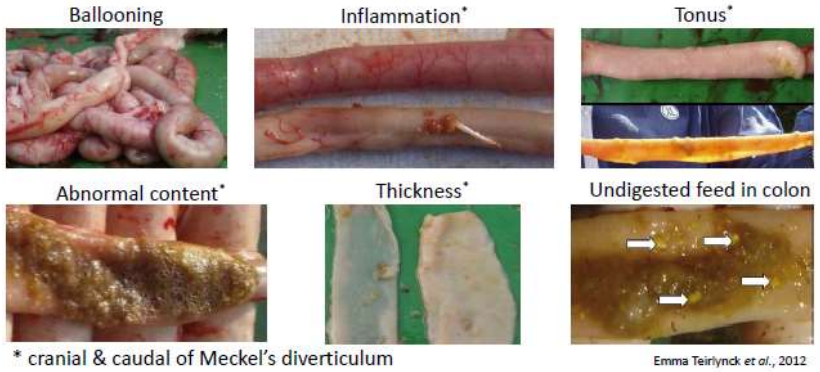

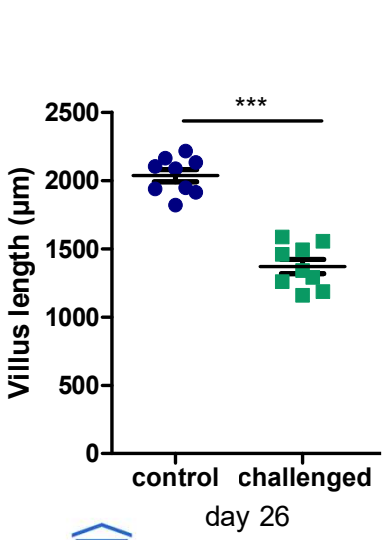

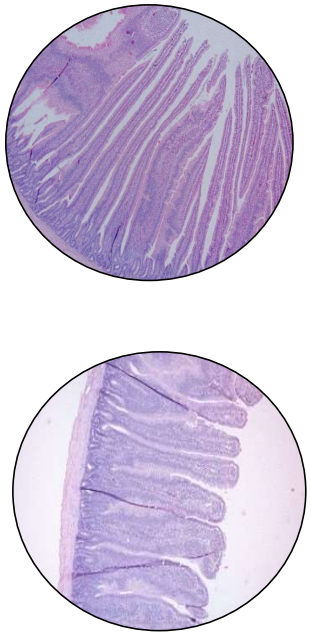

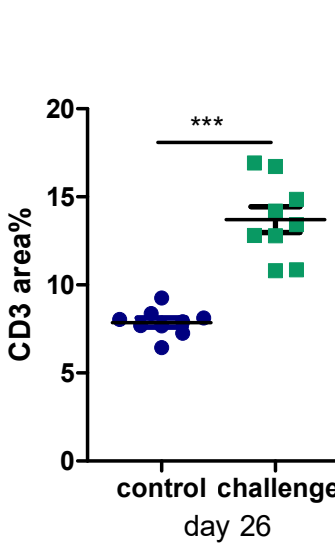

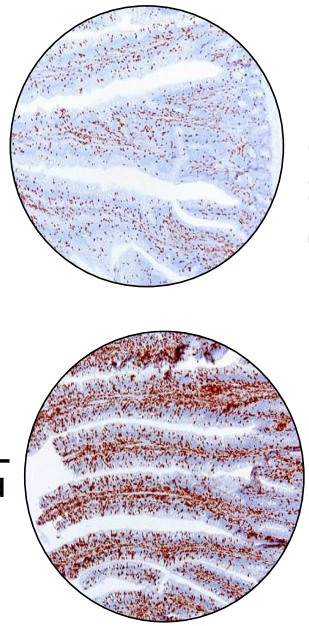

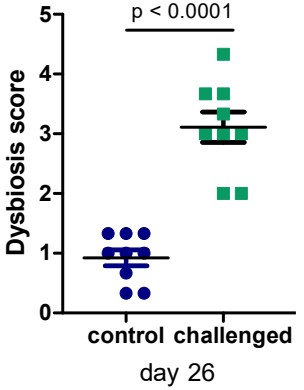

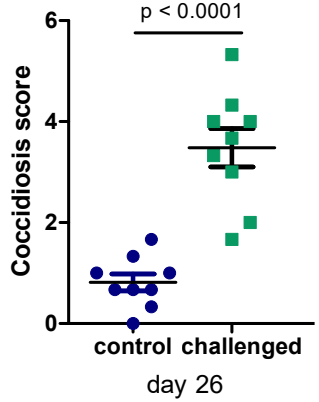

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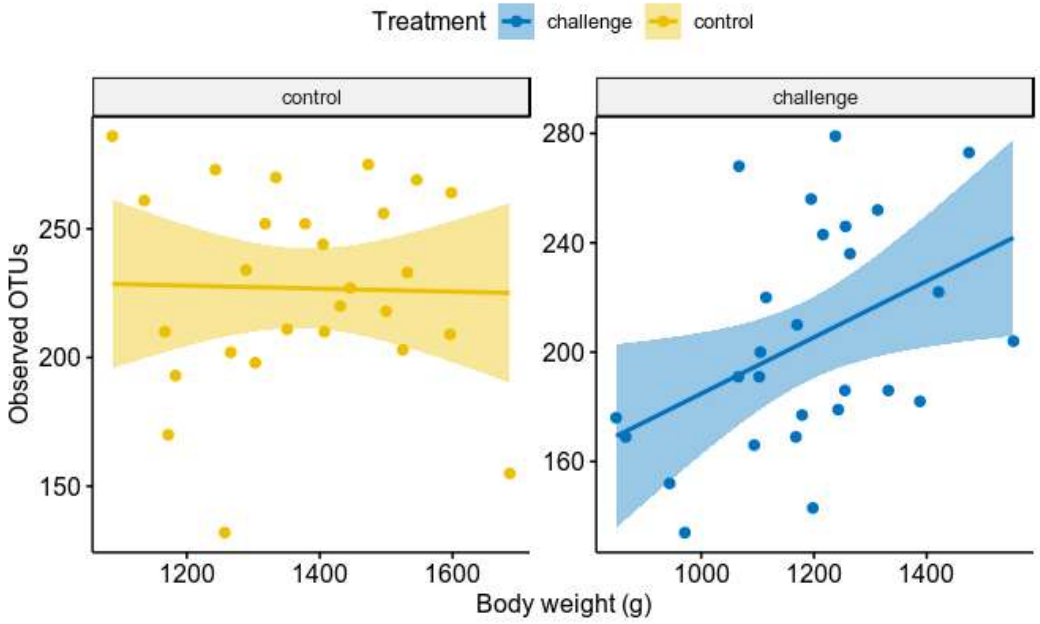
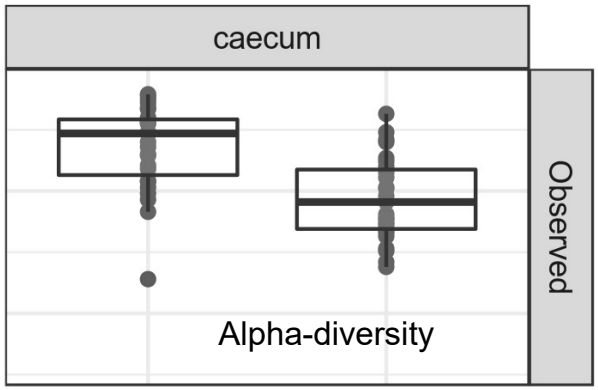
BUTYRATE-PRODUCING ANAEROBIC FERMENTATIVE MICROBIOTA DEPLETION





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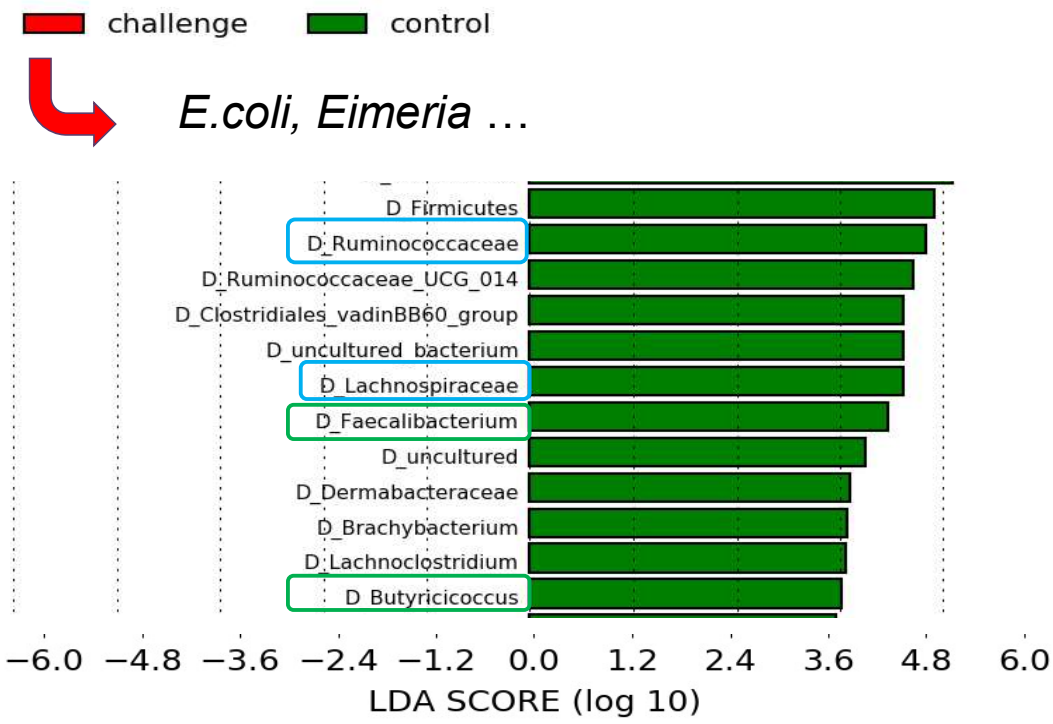


DYSBIOSIS: A UNIVERSAL CONCEPT

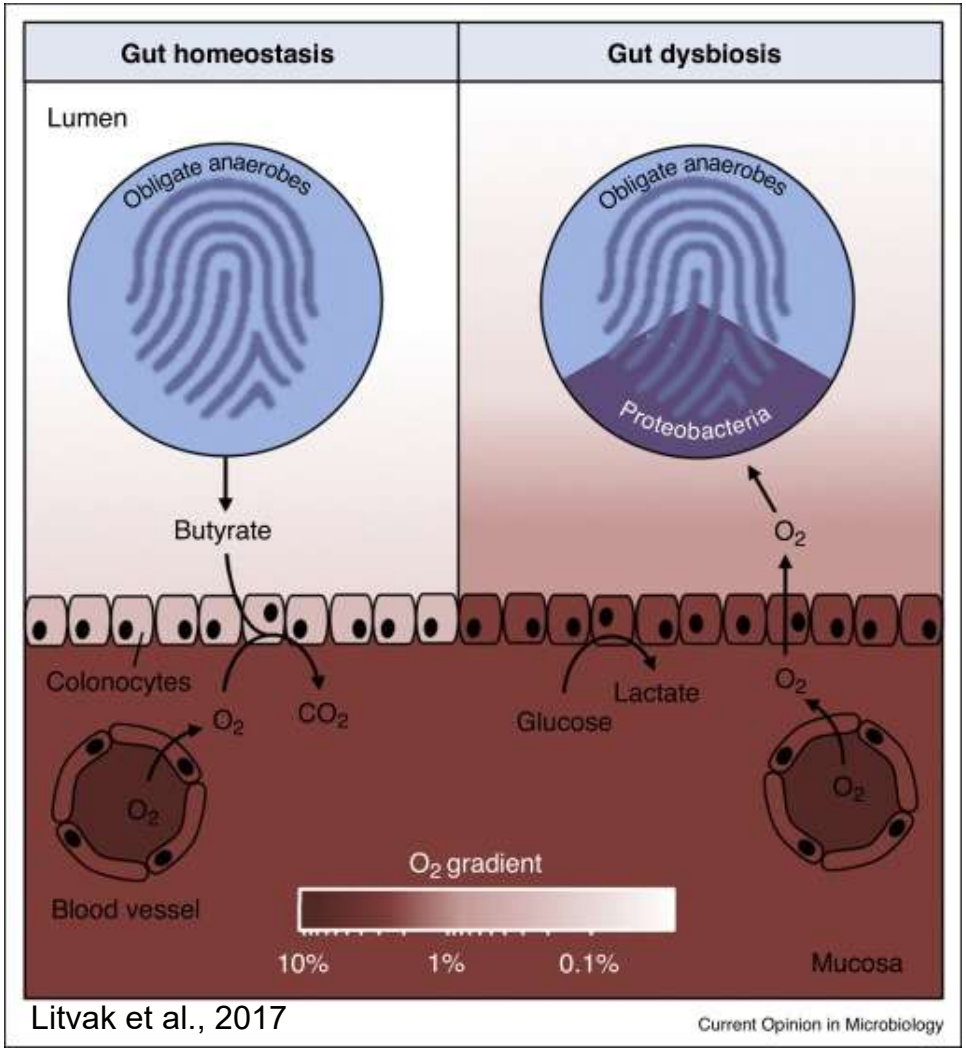
Anaerobic butyrate producers

Anti-inflammatory responses

Epithelial integrity

Cellular homeostasis

Optimal digestion



Aerobic respiration

Inflammation

Epithelial permeability

Loss of bacterial diversity

Loss of anaerobes

Expansion of Proteobacteria

Digestive disturbances

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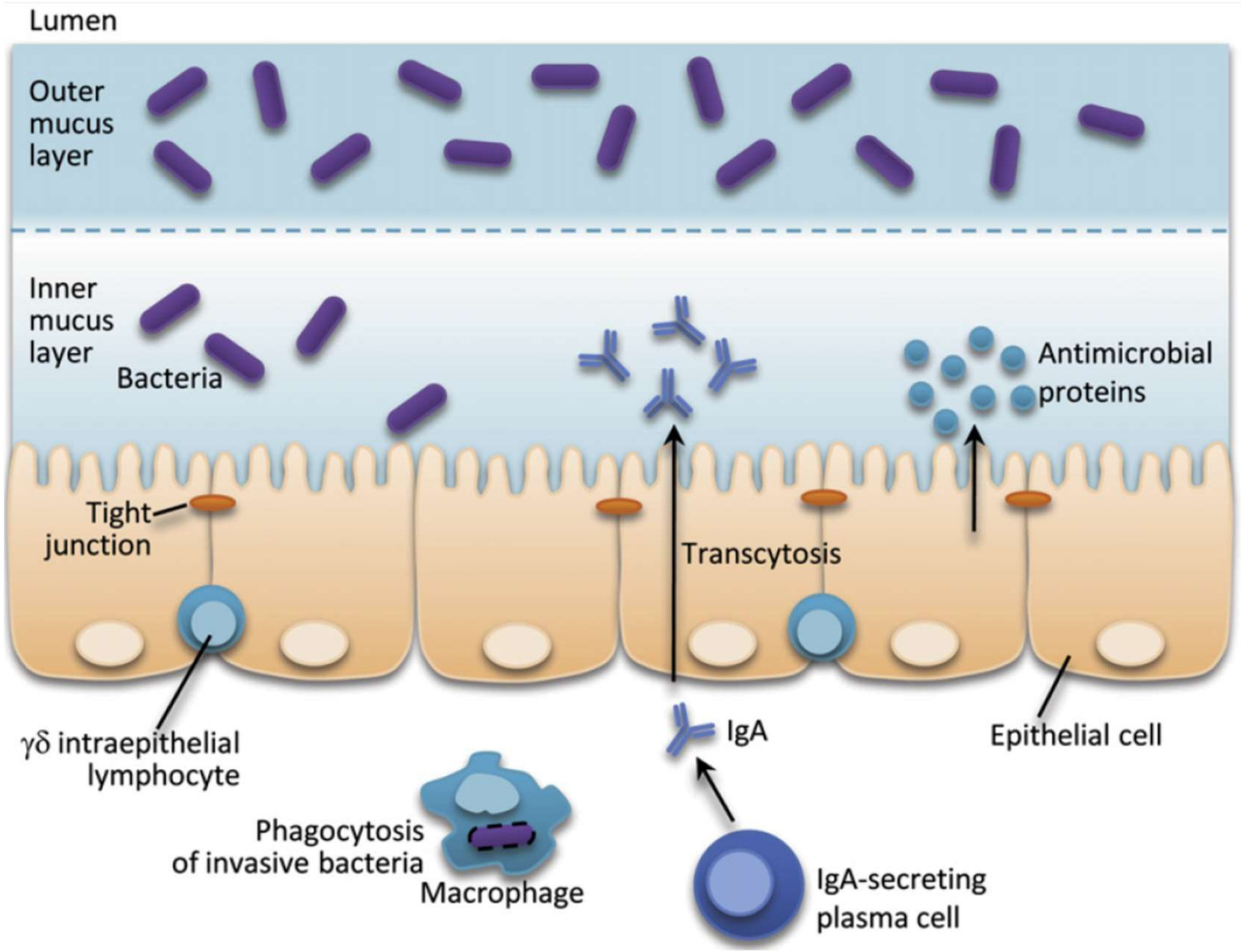
WHY? 2) MUCOSAL IMMUNITY



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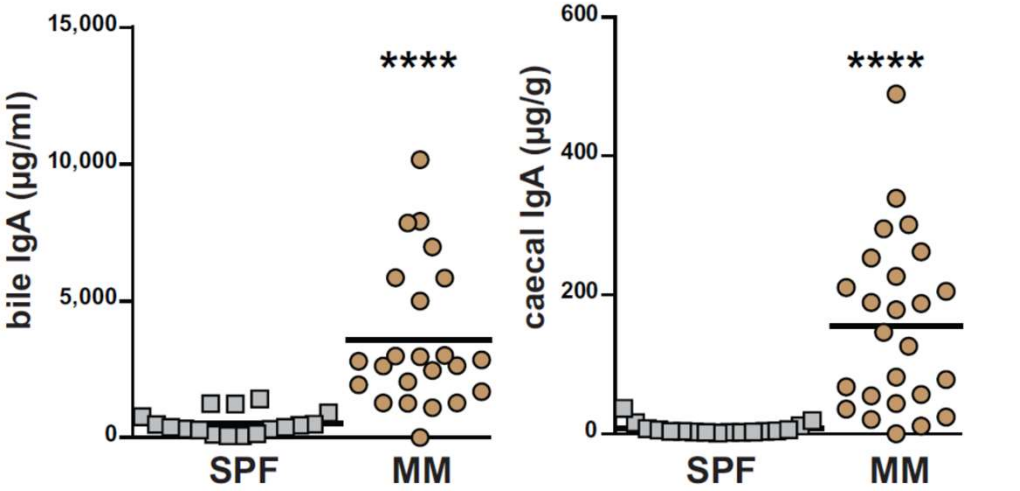
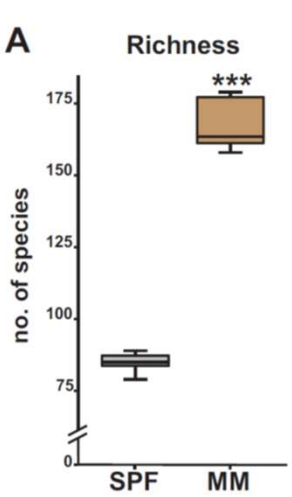
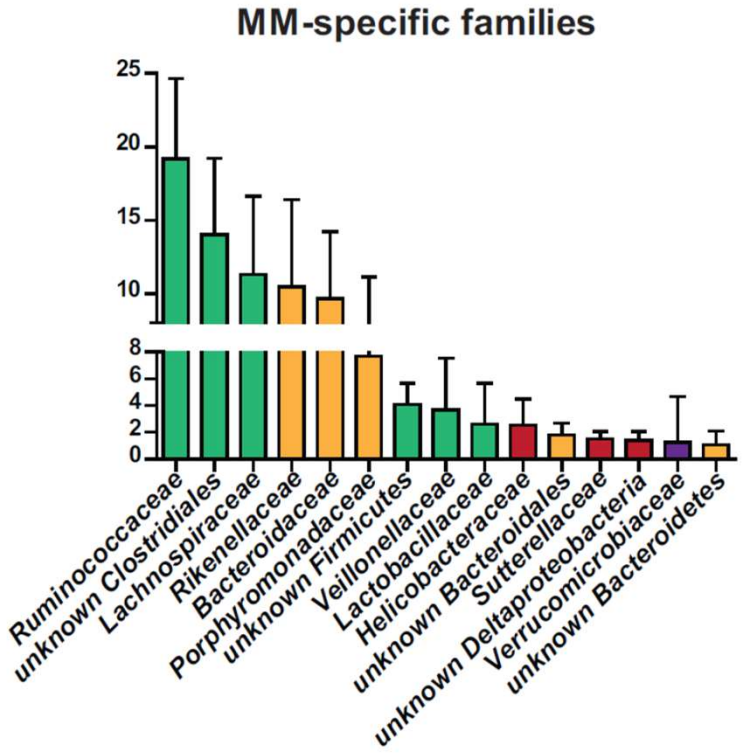
Early-Life Immune System Maturation in Chickens Using a Synthetic Community of Cultured Gut Bacteria

Christian Zenner,[a,b] Thomas C. A. Hitch,[b] Thomas Riedel,[c,d] Esther Wortmann,[b] Stefan Tiede,[c,d] Eva M. Buhl,[e] Birte Abt,[c,d] Klaus Neuhaus,[f] Philippe Velge,[g] Jörg Overmann,[c,d,h] Bernd Kaspers,[a] Thomas Clavel[b]







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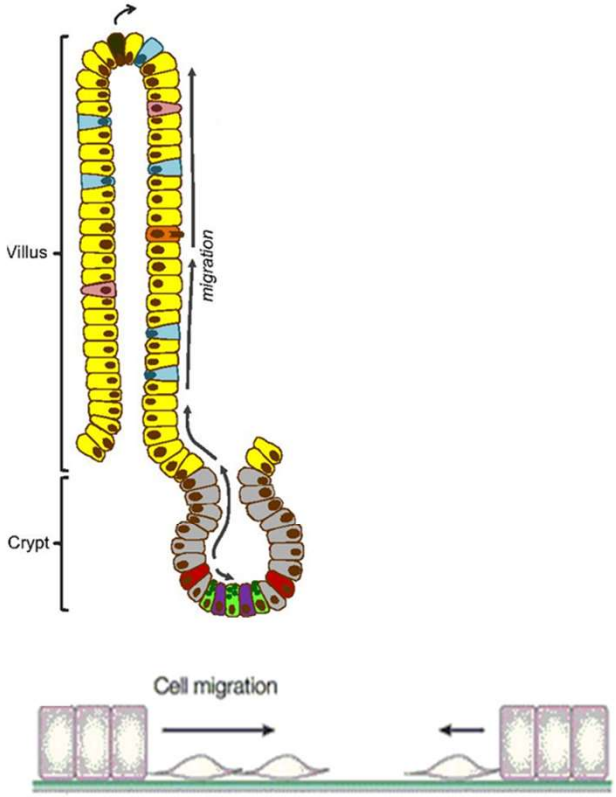
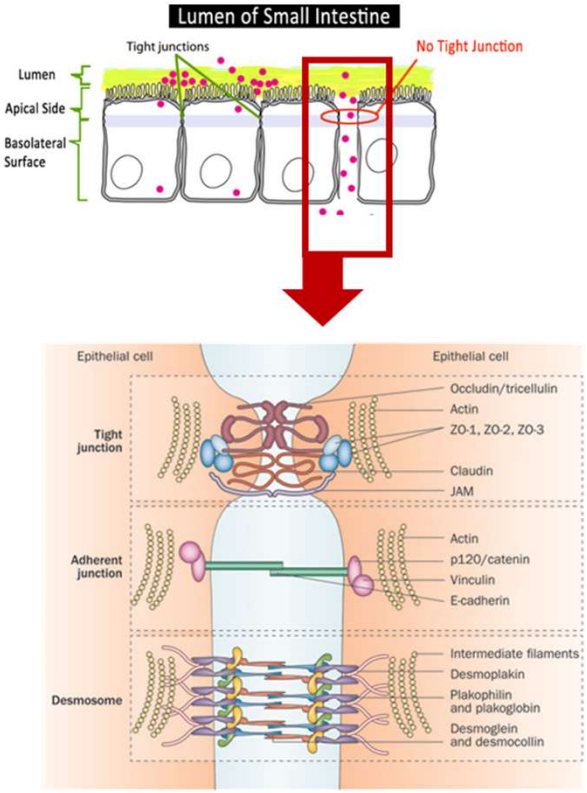
A need for hen-derived microbiota for optimal intestinal immune development

EFFECTS OF THE FERMENTATION ACID BUTYRATE

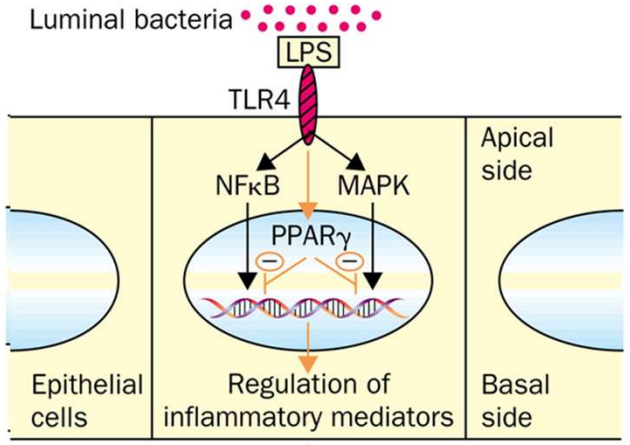
Cell proliferation and migration



Tight junction repair/strenghtening

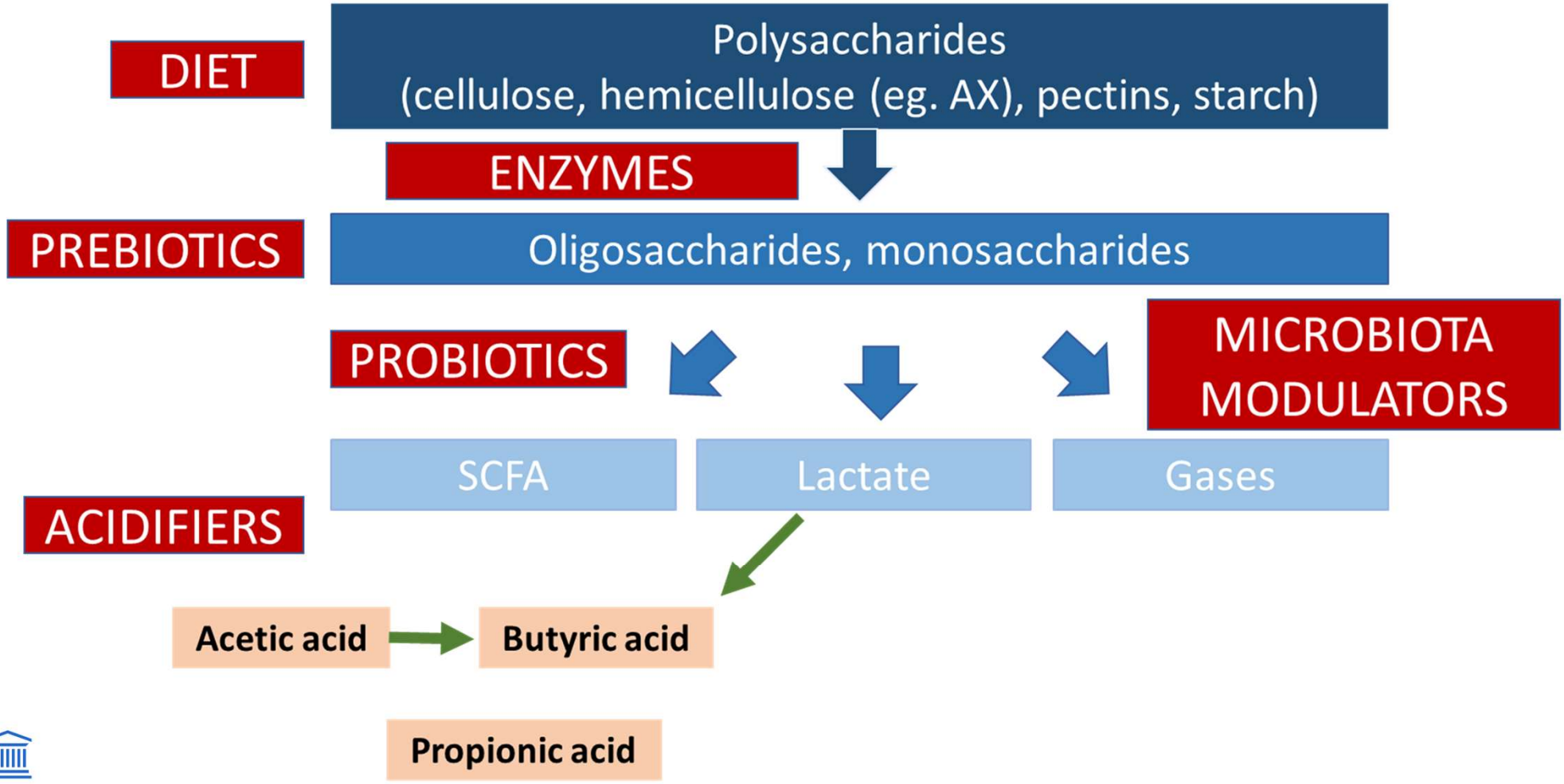


Anti-inflammatory responses



PPARY activation = anti-inflammatory transcription factor

CAN WE INCREASE FERMENTATIVE FIBRE-DEGRADERS IN THE GUT?



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TAKE HOME MESSAGES

- Broilers are sensitive to intestinal pathologies and infections
- Microbiota is immature
- Immune development still ongoing
- Intestinal leakage and infammation

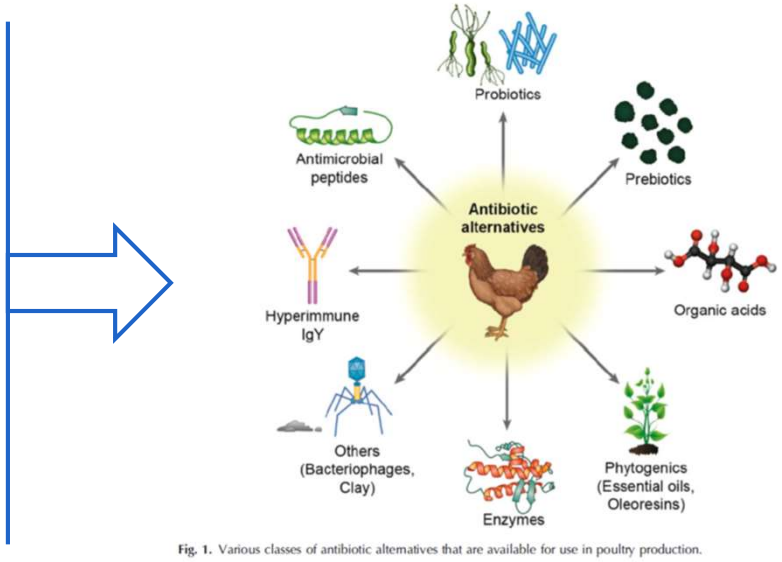

Fig. 1. Various classes of antibiotic alternatives that are available for use in poultry production.

Gadde et al., 2017

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