Poultry Gut Health 2018: Holistic View
Overview

- Importance of gut health in 2018 poultry production
- Normal gut: Interaction of microbiota, immunity and performance: key messages
- Negative gut health drivers
- Bacterial enteritis vicious circle
- How to drive good gut health in 2018? Back to basics!?
Gain in FCR and BW 2018?

- Two important spoilages in broiler production: Maintenance and Immune System
- Progression said ‘mainly from genetics’ but what does it mean?

  - **Behaviour**: high feed intake birds
    - Shortens life span, less nutrients for maintenance
    - More issues with capability of digestion and absorption
    - As soon something goes wrong, bacterial enteritis vicious circle is
    - Historically focus on controlling **bacterial** element of the bacterial enteritis (AGP, probiotics, acids,…) now more need for focus on **enteritis** directly

  - Indications of **changing (innate) immune system** e.g. Enterococcus problems: normal inhabitant, able to slip through (innate immunity) gut barrier
Intestinal surface versus other organs

Human:
- Skin: 2 m²
- Lung: 100 m²
- Intestine: 300 m²

In direct contact with the outer environment
A large percentage of vaccinations goes through drinking water!
What if you stimulate GALT?

- Often overstimulation of the immune system
  - When this happens, immune responses (adaptive and immunity) will further improve, but ADG will stagnate and FCR will increase (Humphrey and Klasing, 2004)

- Ballooning! Thinner *Tunica muscularis*....
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Normal gut microbiota composition

Diversity and Succession of the Intestinal Bacterial Community of the Maturing Broiler Chicken

Jiangrang Lu,1 Umelaalim Idris,1 Barry Harmon,2 Charles Hofacre,1 John J. Maurer,1,3 and Margie D. Lee1,3*

Department of Avian Medicine1 and Department of Pathology,2 College of Veterinary Medicine, The University of Georgia, Athens, Georgia 30602, and Center for Food Safety, The University of Georgia, Griffin, Georgia 302233

A

B

Ileum

Cecum

Mainly Gram positives

Lactobacillaceae
Clostridiaceae
Bacillus
Streptococcaceae
Enterococcaceae
Actinobacteria
Proteobacteria
Flavobacteriaceae
Bacteroidaceae
Unknown bacteria
Polysaccharides

Oligosaccharides

Monosaccharides

Bacteroidetes, lactobacilli, bifidobacteria, ...

Lactate, acetate

Van Immerseel
Polysaccharides

Oligosaccharides

Monosaccharides

Bacteroidetes, lactobacilli, bifidobacteria, …

Lactate, acetate

Firmicutes

Clostridium cluster IX

Propionate

Firmicutes

Clostridium cluster IV and XIVa

Butyrate

Van Immerseel
Polysaccharides

Oligosaccharides

Monosaccharides

Firmicutes, Clostridium cluster IX

Bacteroidetes, lactobacilli, bifidobacteria, …

Lactate, acetate

H₂

SO₄²⁻

H₂S

CH₄

Methanogenic bacteria (Archaebacteria)

Proteobacteria

Sulphate reducers (SRB), e.g. Desulfovibrio

Also Enterobacteraceae (SALMONELLA !)

Van Immerseel
Protein metabolisation

Proteins → Peptides → Amino acids

- Branched chain fatty acids
- \( \text{NH}_3 \)
- Biogenic amines
- Indoles
- Neurotransmitters
Protein metabolism

Proteins → Peptides → Amino acids

- Branched chain fatty acids $\text{NH}_3$
- Biogenic amines
- Indoles
- Neurotransmitters

$\text{H}_2\text{S}$
An example: Firmicutes
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Gut Health: main negative drivers 2018

- **Infectious causes**
  - **Bacterial**: mainly
    - *Clostridium perfringens* (Necrotic Enteritis)
    - Clostridiaceae (Bacterial Enteritis, BE) and other undefined overgrowth – This is ‘new’ – emerging since 2000
  - **Parasitological**: mainly protozoal *Eimeria* spp. causing subclinical damages - This is old – since 1900
  - **Viral**: broilers ‘black box’ for the moment: rota-, corona-, entero-, adeno-, astro- and reoviruses

- **Feed Quality and Management**
  - **Anti-Nutritional Compounds**
    - Non starch Polysaccharides
    - Mycotoxins
    - ...
  - **Poor physical texture / Form of Feed**
    - Structure in feed helps developing the gut physiology and improving gut health
  - **Poor feed management with 2018 “high-intake” broiler lines**
Coccidiosis =main pre-disposing factor NE and bacterial enteritis!

0. Normal gut with well developed villi

1. Coccidia infecting gut mucosa, causing villus atrophy

2. Damaged gut reacts by: villus fusion, increase of mucus production Goblet cells and immune reaction causing inflammation

3. Immune reaction and damage causes plasma protein leakage/ intestinal function decreased, more nutrients in gut

4. Clostridiaceae (rods) grow on available nutrients, mucus and plasma proteins and attach to gut lining, causing further reaction of immune system and gut defences (mucus,...)
Histology

Inflammation

Goblet cells, heterophile infiltration

Villi: fusion, length

Crypt hyperplasia
Bad intestinal health: Dysbacteriosesis/BE
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Vicious cycle of pathogenesis of BE

**High feed intake**, high NSP levels, coccidiosis, mycotoxines, viruses

Presence of nutritional factors that favour some bacterial groups and disfavour others causing disbalance

Inflammation and oxidative stress caused by interference of microbiota with mucosa

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Solutions to vicious circle

- Reduce feed intake
- Limit NSP levels
- Anticoccidial program
- Mycotoxin binder

Vicious circle Hypothesis

- AGP
- Ionophores
- Organic acids
- Pre/probiotics
- Phytotherapeutics
- Beta-glucans
- Antimicrobial peptides
- Bacteriophages

- Enzymes
- Feed structure
- Fiber
- Phytogenics

- Organic acids
- probiotics
- Beta-glucans
- MOS
- AGP?
- Phytogenics

De Gussem, 2010
Reduce oversupply of nutrients

- Reduce feed intake
- Limit NSP levels
- Anticoccidial program
- Mycotoxin binder

- Restricted feed intake: to avoid
- Limit NSP levels: choice of feed ingredients
- ACP-program: proper rotation between classes
- Mycotoxins: also a risk at low levels
Shift in microbiota

- AGP: antibacterial?
- Ionophores antibiotic effect
- OA: medium chain fatty acids
- Probiotics: mode of action!
  - Bacteriocins
  - Fermentation substrate
- Prebiotics: target?
- Beta-glucans

- Phytotherapeutics
- Antimicrobial peptides
- Bacteriophages

- AGP
- Ionophores
- Organic acids
- Pre/probiotics
- Phytotherapeutics
- Beta-glucans
- Antimicrobial peptides
- Bacteriophages
Alterations in the gut

- OA: butyric acid
- Probiotics
  - Immunomodulating metabolites
- Beta-glucans
- Mannan Oligo Saccharides
- AGP: immunomodulating?
- Phytogenics

- Organic acids
- Probiotics
- Beta-glucans
- MOS
- AGP?
- Phytogenics
Digestion and absorption of nutrients

- Enzymes
- Feed structure
- Fiber
- Phytogenics

- Enzymes: mainly for NSP’s
- Feed structure: pellet vs mash
- Fiber ~ structure
- Phytogenics
Alternatives to enhance gut health

- Break VC with solutions on all 4 steps of VC!

- Alternative approaches supporting
  - Control the microbial ecosystem
  - Host defense: gut barrier management, integrity and recovery of intestine
How to choose the right alternatives?

- Think of vicious circle

- Diagnose your flocks and measure what is affecting gut health
  - Use scoring methods which are uniform and as objective as possible

- Do you see patterns? (poor tonus, undigested feed, inflammation, ….)

- What are primary causes of relative oversupply nutrients? (coccidiosis, mycotoxins, viruses, parasites, anti-nutrional factors feed, feed structure, NSP, NE, ….)
How to chose the right alternatives?

- **Physiological and histological impact of BE on technical performance?**
  - **Estimate the cost** of gut health BE and coccidiosis (20 BDT per bird?)

- What do you do already to facilitate digestion/absorption
  - **List all additives and feed components** that are included in program to improve gut health or can impact it
  - Calculate the **cost for each** of them and list
  - Check also drinking water additives
  - Include **management actions** to cope with or steer consequences of bad gut health (litter type, ventilation strategy, …)
  - Are there **synergies** between them, **copy cats** or **antagonists**
    - Synergies with enzymes that reduce oversupply nutrients and MCFA that reduce Clostridiaceae load in small intestine
    - Copy cats: Often nutritionist adds acid in feed, vet in drinking water…
    - Probiotic and Mycoplasma antibiotic control that kills probiotic

- **THINK**
How to choose the right alternatives?

- Bring together veterinarian, nutritionist and production manager to decide where vicious circle BE is well controlled, lacks control, and where you might be overshooting
  - Additional tools needed: what function?
  - What types of products you can eliminate?
- Check in vitro data of products and tools presented
  - Could be MIC, or cell culture data
- Check in vivo floor pen and battery cage trials
  - Where do the challenges compare to your field challenge?
- Set up your own field trial using scoring system next to performance data in order to validate progress
  - Don’t waste too much time: don’t re-invent the wheel (large scale introduction of products but with evaluating gut health directly, not just FCR and ADG)
Thank you for your attention
Questions:
Hannes.Meyns@vetworks.eu
+32 487.10.40.53