ANIMAL MICROBIOME RESEARCH & INNOVATION

Dr Kirsty Gibbs, Poultry Lead, Innovation, Danisco Animal Nutrition & Health (IFF)
WHY DOES (OR SHOULD!) THE ANIMAL PROTEIN INDUSTRY CARE ABOUT THE MICROBIOME?
ANIMAL PROTEIN DEMAND CONTINUES TO RISE

Global protein market 2022-2030

- Projections 2021-2031
  - Animal protein: +16%
  - Seafood: +12%
  - Eggs: +22%
  - Beef: +8%
  - Pork: +9%
  - Poultry: +26%

Global meat and egg consumption growth 2021-2031

- 55% of growth in Asia
- 20% in Latin America
- 15% in Africa
- 10% in emerging markets

There is a significant gap in grain availability, land availability and green house gas mitigation goals to grow this much animal protein in the years to come
THE ANIMAL PROTEIN INDUSTRY HAS MANY HEADWINDS

Feed grain prices and inorganic phosphate prices have rocketed in the last 2 years

Various frameworks & high targets adds pressure across the industry

Feeding costs account for over 70% of total production costs

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CONFUSED.COM: MICROBIAL CHALLENGES IN PRODUCTION SYSTEMS

Opportunists » Emerging » Re-emerging » Zoonotics » True pathogens…?

Necrotic Enteritis
Clostridium perfringens
Typically, 18-28 days
Distal ileum
Opportunist?

Coccidiosis
Eimeria spp
Typically, 3-5 weeks
Dependent on species
Endemic

Dysbiosis
No defining microbe
Bacterial Enteritis
Disturbed gut balance
Predisposes to Cocci/NE

Zoonotics
Campylobacter/ Salmonella
May/may not cause problems for bird
Human health risk

…. E. coli (APEC), Enterococcus, Brachyspira, viruses….
**WHY ARE BROILERS PRONE TO GUT HEALTH CHALLENGES?**

Short life spans and artificial rearing conditions

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Takes 3 weeks for intestinal immunity to develop

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THE AVIAN PATHOGENIC E. COLI (APEC) BURDEN

APEC impacts from early life to end of production broilers, layers, breeders & Turkeys

Syndromic infections with varying clinical pathologies are the result of a complex multifactorial aetiology and opportunistic in nature.

Early mortality, chick quality, mortality breaks and condemnations at slaughter
BROILERS ARE INCREASINGLY SUSCEPTIBLE TO EARLY INFECTION WITH BAN OF GENTAMYCIN AT HATCHERIES & INCREASED SETTING OF POOR-QUALITY EGGS

Pathogenic *E. coli* are known to colonise naïve guts quickly

Husbandry/managing considerations
- Gut integrity (breach in barrier)
- Maternal gut health
- Ventilation & litter quality/treatment (fecal dust)
- Gut health/reservoir (reducing source of infection)
ENTEROCOCCUS GENUS: A DIVERSE GROUP

With many faces…

Digestive systems
- Commensal
  - Human
  - Animals
  - Insects

Natural biomes
- Water
- Sewage
- Soil
- Arable lands

• Immune homeostasis
• Immunomodulatory effect
• Produce bacteriocins against pathogens
• Role in digestion (metabolism of carbohydrates & proteins)
• Lowering cholesterol level

• Potential pathogens, translocation in the circulatory system
• Transferable virulence and resistance factors between species & genera
• Foodborne pathogens

Biotherapeutic / Probiotic
• Microbial feed additive to improve growth performances

AAFCO (2018) approved list
- E. cremoris; E. diacetylactis
- E. faecium; E. intermedius
- E. lactis; E. thermophilus

EU QPS list
Ø Enterococcus spp.
ENTEROCOCCUS - EMERGING OR RE-EMERGING PATHOGEN?
Definitively increasing worldwide

Ex: French epidemiological data from 1993 to 2020

Evolution of the relative frequency of *Enterococcus* and of the number of *Enterococcus* species for all poultry production sectors (n= 12,177 Enterococcus cases)

Evolution of scientific articles counts answering « *Enterococcus cecorum* » request PubMed database

Souillard et al., 2022 Vet Microbiol.

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ANTIBIOTICS ARE NOT THE SOLUTION

Due to the high prevalence of ABR and ability to acquire and transfer ABR genes

At the genus level across continents

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<th>Continent</th>
<th>Aminopenicillins</th>
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<th>Fluoroquinolones</th>
<th>Gentamicin</th>
<th>Lincosycin</th>
<th>Macrolide/Lincosamide/Streptogramin</th>
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At the species level

Prevalence of the resistance of *E. cecorum* poultry isolates (n=118)

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<th>Antimicrobial</th>
<th>Resistance Prevalence</th>
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<td>Tetracycline</td>
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<td>MLS</td>
<td>75%</td>
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Assessment of listing and categorisation of animal diseases within the framework of the Animal Health Law (Regulation (EU) No 2016/429): antimicrobial-resistant *Enterococcus cecorum* in poultry

Laurentie et al., 2023, J Clin Microbiol, 61 (3); Laurentie et al., 2023 mSphere, 8 (2)
Sharma et al., 2020, Foods, 9, 686
HEALTH & PERFORMANCE GO HAND IN HAND

Accurately identify the issue and environmental contributions before determining the best course of preventative measures

**The Host**
*Identify host response*
- Clinical/subclinical symptoms
- Physiological parameters (age, stress)
- Differentiate between conditions

**The Microbes**
*Know who is causing the problem*
- True infection vs opportunist
  - Microbial behaviour
  - Source/contamination

**Feed/management**
*Determine which external factors are contributing*
- Diet – raw materials, pellet size
- Environment (litter, free range, season)
- Predisposing factors (e.g. cocci)
DIFFERENT DIETS, DIFFERENT ANTI-NUTRITIONAL FACTORS

Antinutritional factors impact digestion – Leading to reduced animal performance

CORN
Anti-nutritional factors
Arabinoxylans
Resistant starch
Hemicellulose
Cellulose

BY PRODUCTS
Anti-nutritional factors
Arabinoxylans
Resistant starch
Storage protein
Glucans
Cellulose
Hemicellulose

SOYBEAN MEAL
Anti-nutritional factors
Storage protein
Trypsin inhibitors
Lectins
Xyloglucans
Pectins

WHEAT
Anti-nutritional factors
Arabinoxylans
Hemicellulose
Cellulose
FEED ADDITIVES HAVE TAKEN THE NEXT LEAP
No longer solely used for digestibility enhancement

NUTRITION
Optimal nutrient availability and digestion to maximize performance

NUTRIBIOSIS

HEALTH
Supports optimal health and antibiotic free production
EXOGENOUS ENZYMES PLAY A ROLL IN HEALTH & PERFORMANCE

Short arabinose xylose sugars (AXOS)
Prebiotic effect (SCFA production)

Improved digestion
AMINO ACIDS
FAT
STARCH

Nutrients Locked by Fibre, reduce viscosity
Undigested Nutrients, reduce protein reaching distal gut and avoid NE blooms
WHAT IS THE ANIMAL PRODUCTION INDUSTRY ASKING FOR?

☐ Consistently performing, cost effective alternatives to antibiotics

☐ Biomarkers to measure health at flock or herd level

☐ Predictability in disease outbreaks

☐ Understanding of which specific management practices contribute to disease output