



## ANIMAL MICROBIOME RESEARCH & INNOVATION

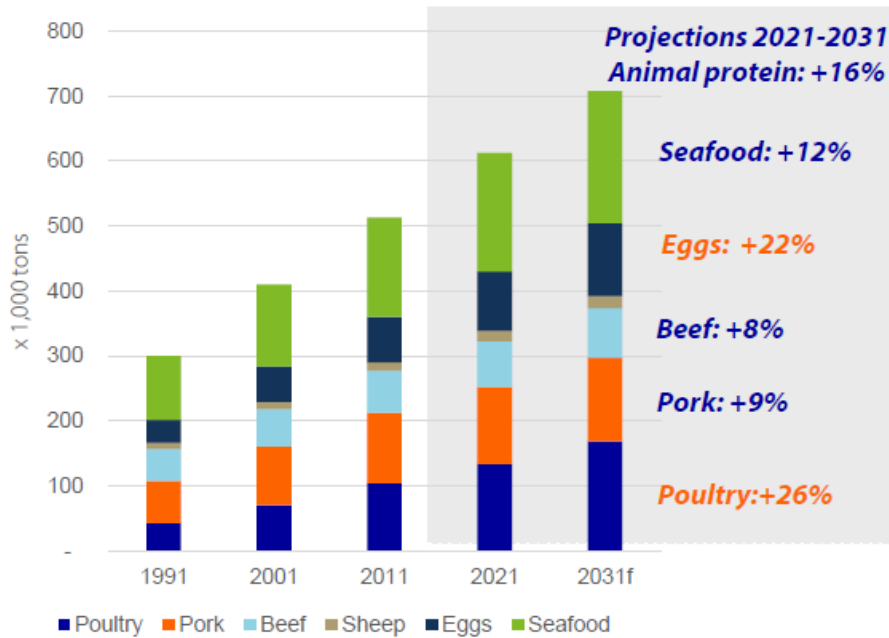
Dr Kirsty Gibbs, Poultry Lead, Innovation,  
Danisco Animal Nutrition & Health (IFF)

Rephrased . . .

**WHY DOES (OR *SHOULD!*) THE ANIMAL PROTEIN INDUSTRY  
CARE ABOUT THE MICROBIOME?**

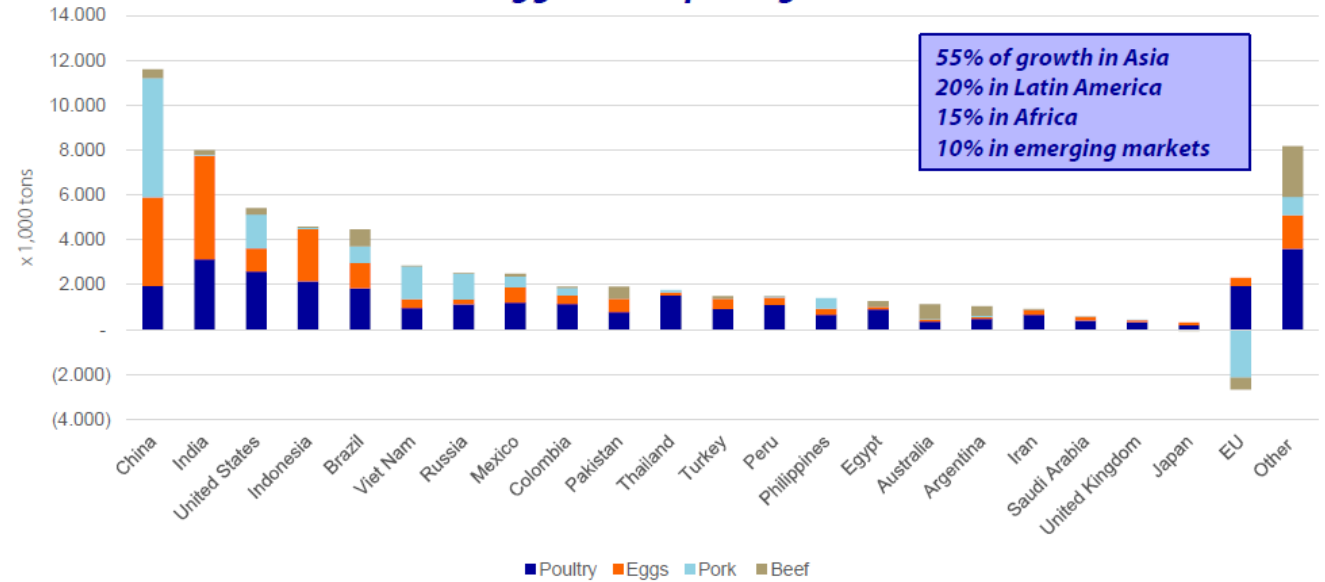
# ANIMAL PROTEIN DEMAND CONTINUES TO RISE

### Global protein market 2022-2030



Source: Rabobank, FAO, USDA, local statistics 2023

### Global meat and egg consumption growth 2021-2031f

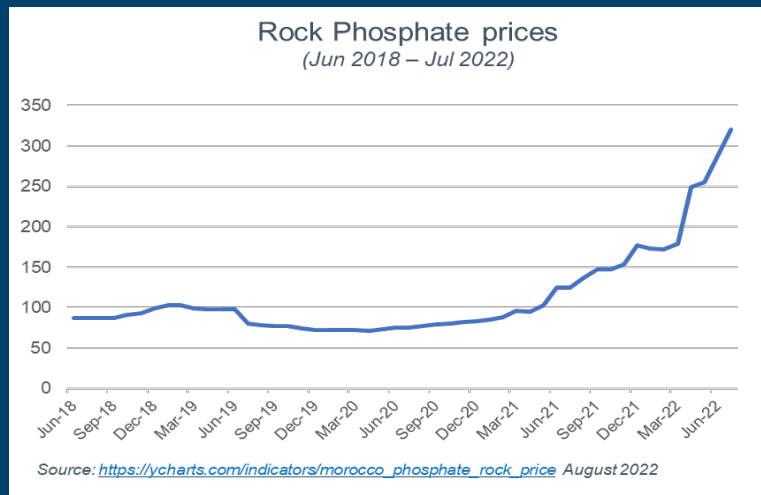
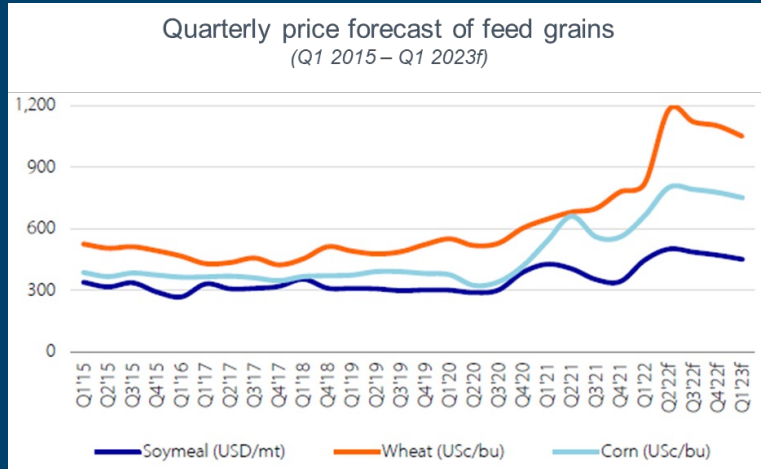


Source: Rabobank, FAO, USDA, local statistics 2023

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



### 2030 Targets for sustainable food production

| PESTICIDES                                                           | NUTRIENT LOSSES                                                                                  | ANTIMICROBIALS                                                    | ORGANIC FARMING                                              |
|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------|
| 50%                                                                  | 50%                                                                                              | 50%                                                               | 25%                                                          |
| Reduce the overall use and risk of chemical and hazardous pesticides | Reduce nutrient losses by 50% whilst retaining soil fertility, resulting in 20% less fertilisers | Reduce sales of antimicrobials for farmed animals and aquaculture | Increase the percentage of organically farmed land in the EU |

#EUFarm2Fork #EUGreenDeal

European Commission

Feeding costs account for over 70% of total production costs



# 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*

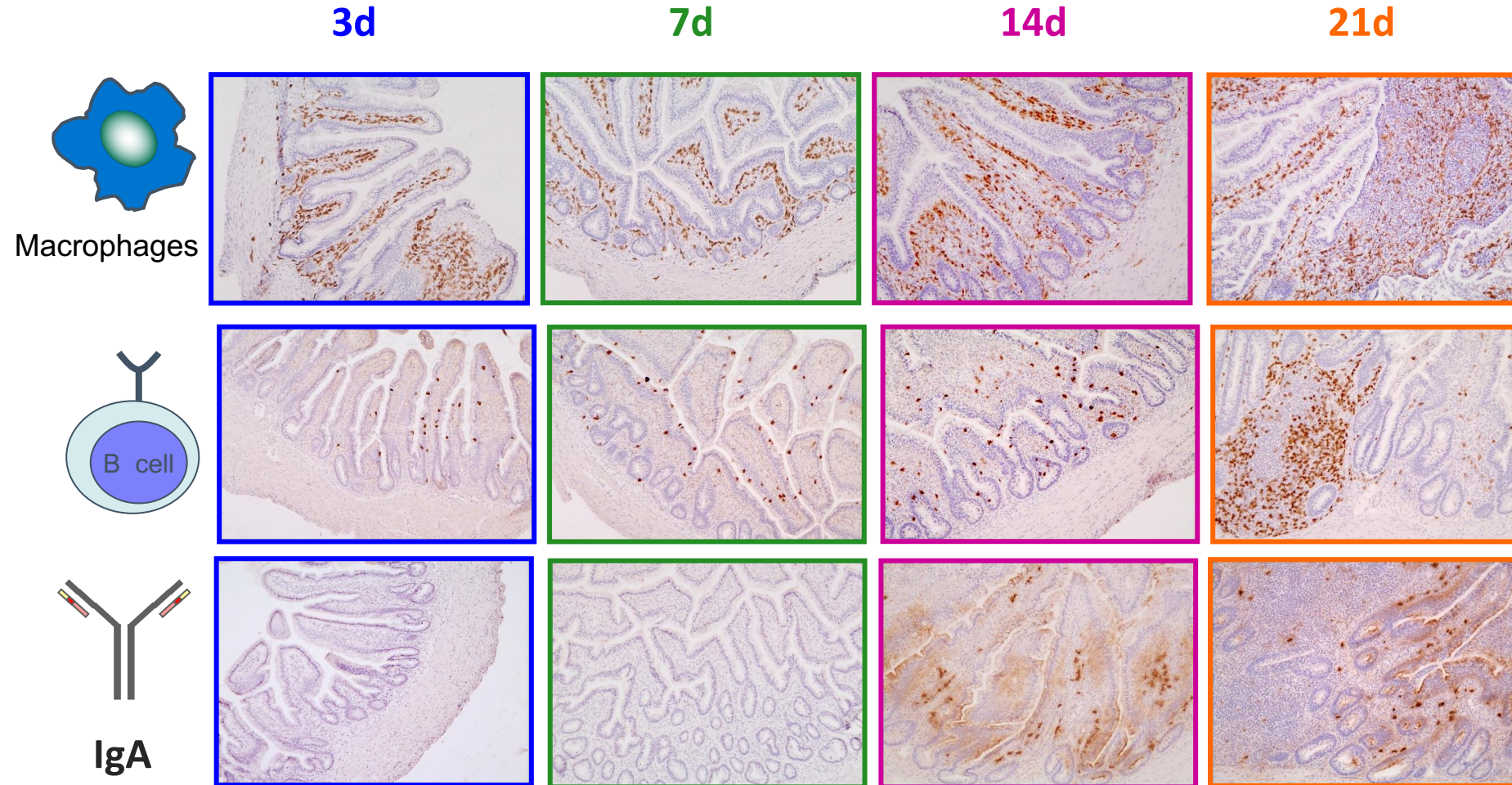
May/may not cause problems for bird

Human health risk

.... *E. coli* (APEC), *Enterococcus*, *Brachyspira*, viruses...

# WHY ARE BROILERS PRONE TO GUT HEALTH CHALLENGES?

Short life spans and artificial rearing conditions



Takes 3 weeks for intestinal immunity to develop

# THE AVIAN PATHOGENIC E. COLI (APEC) BURDEN

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

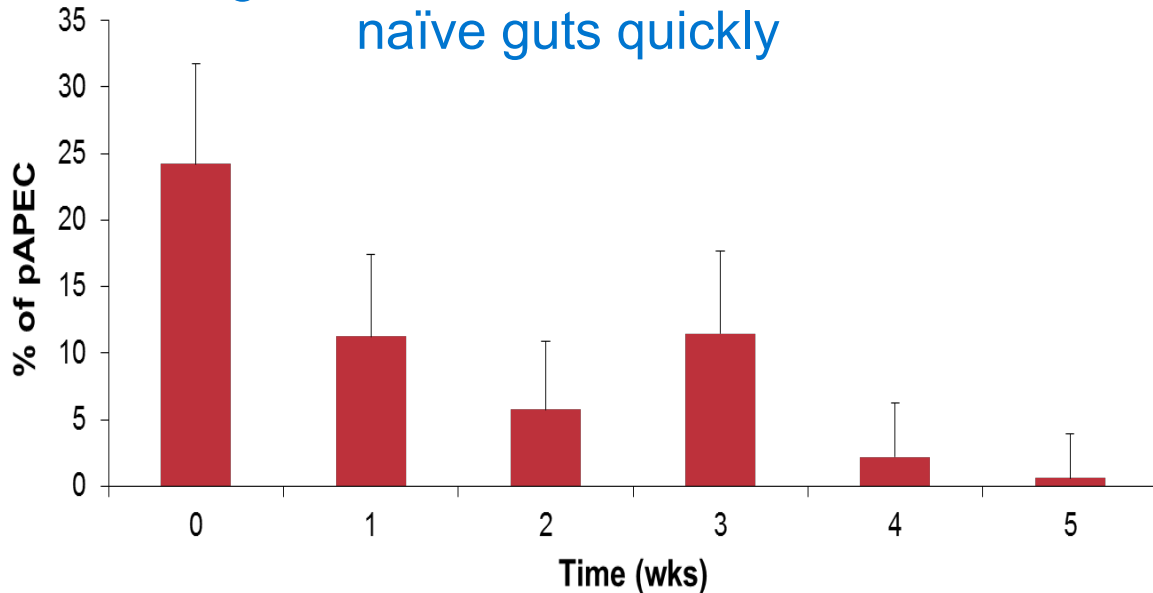


Syndromic infections with varying clinical pathologies are the result of a complex multifactorial aetiology and opportunistic in nature.

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



OPEN ACCESS Freely available online

PLOS

## A Longitudinal Study Simultaneously Exploring the Carriage of APEC Virulence Associated Genes and the Molecular Epidemiology of Faecal and Systemic *E. coli* Commercial Broiler Chickens

Kirsty Kemmett<sup>1\*</sup>, Tom Humphrey<sup>1</sup>, Steven Rushton<sup>3</sup>, Andrew Close<sup>3</sup>, Paul Wigley<sup>1</sup>, Nicola J. Willis<sup>1</sup>

<sup>1</sup> Institute of Infection and Global Health, Department of Infection Biology, School of Veterinary Science, The University of Liverpool, Neston, Cheshire, United Kingdom, <sup>2</sup> Institute of Infection and Global Health, Department of Epidemiology and Population Health, School of Veterinary Science, The University of Liverpool, Neston, Cheshire, United Kingdom, <sup>3</sup> School of Biology, Newcastle University, Newcastle Upon Tyne, United Kingdom



### Avian Pathology

Publication details, including instructions for authors and subscription information:  
<http://www.tandfonline.com/loi/cavp20>

### The contribution of systemic *Escherichia coli* infection to the early mortalities of commercial broiler chickens

K. Kemmett<sup>a</sup>, N. J. Williams<sup>a</sup>, G. Chaloner<sup>a</sup>, S. Humphrey<sup>a</sup>, P. Wigley<sup>a</sup> & T. Humphrey<sup>a</sup>  
<sup>a</sup> Zoonotic Infections of People, Pigs and Poultry Group, Institute of Infection & Global Health and School of Veterinary Science, University of Liverpool, Leahurst Campus, Neston, UK  
Published online: 16 Dec 2013.



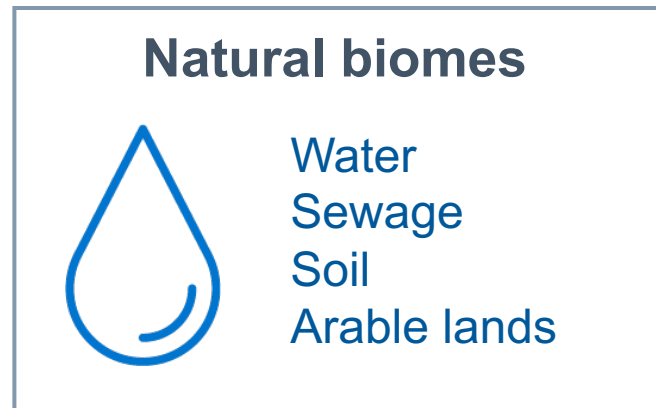
## Husbandry/managing considerations

- 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

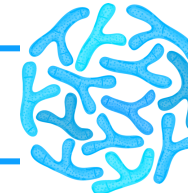
With many faces...



- 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



AAFCO (2018) approved list  
*E. cremoris*; *E. diacetyllactis*  
*E. faecium*; *E. intermedius*  
*E. lactis*; *E. thermophilus*

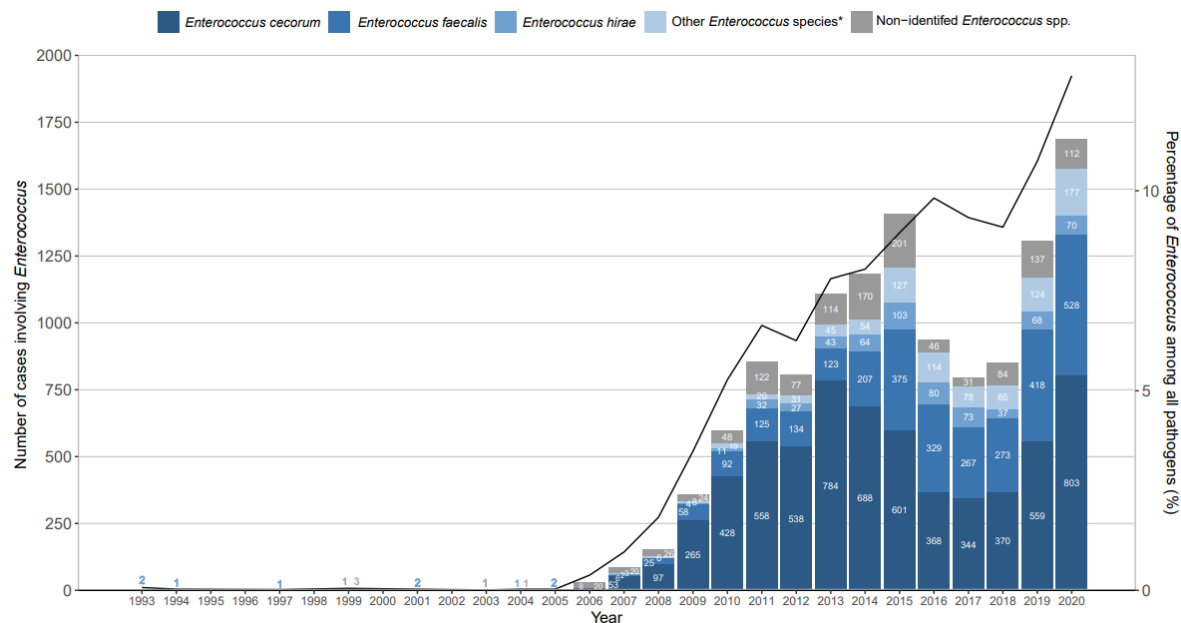
EU\_QPS list  
Ø *Enterococcus* spp.

# 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)

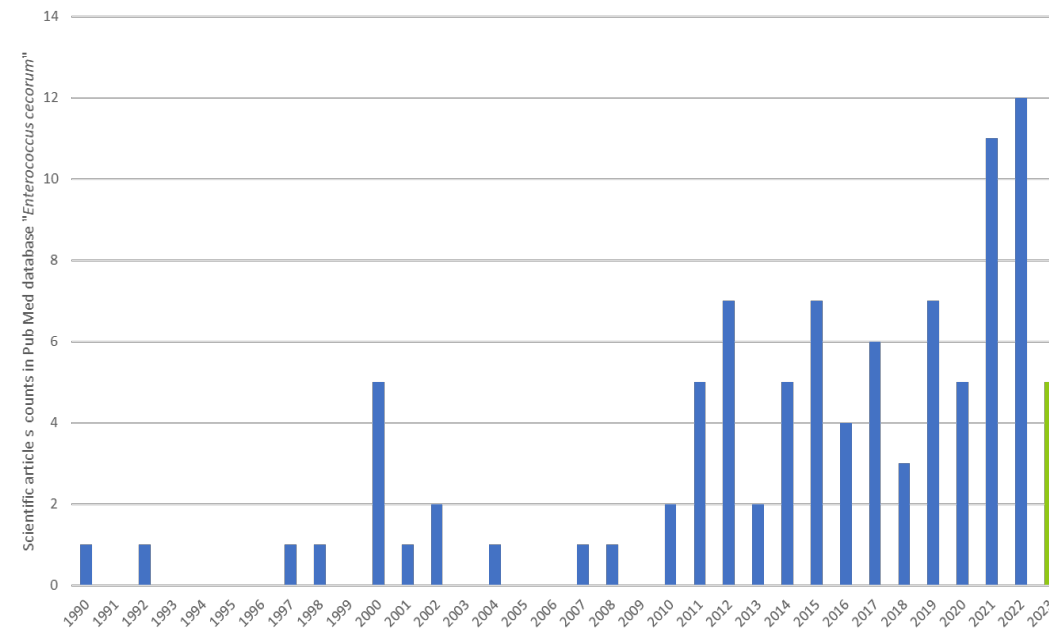


\* Other Enterococcus species covers *E. gallinarum*, *E. faecium*, *E. casseliflavus*, *E. durans*, *E. avium* and *E. columbae*.

Souillard et al., 2022 Vet Microbiol.

## Triggering scientific interest

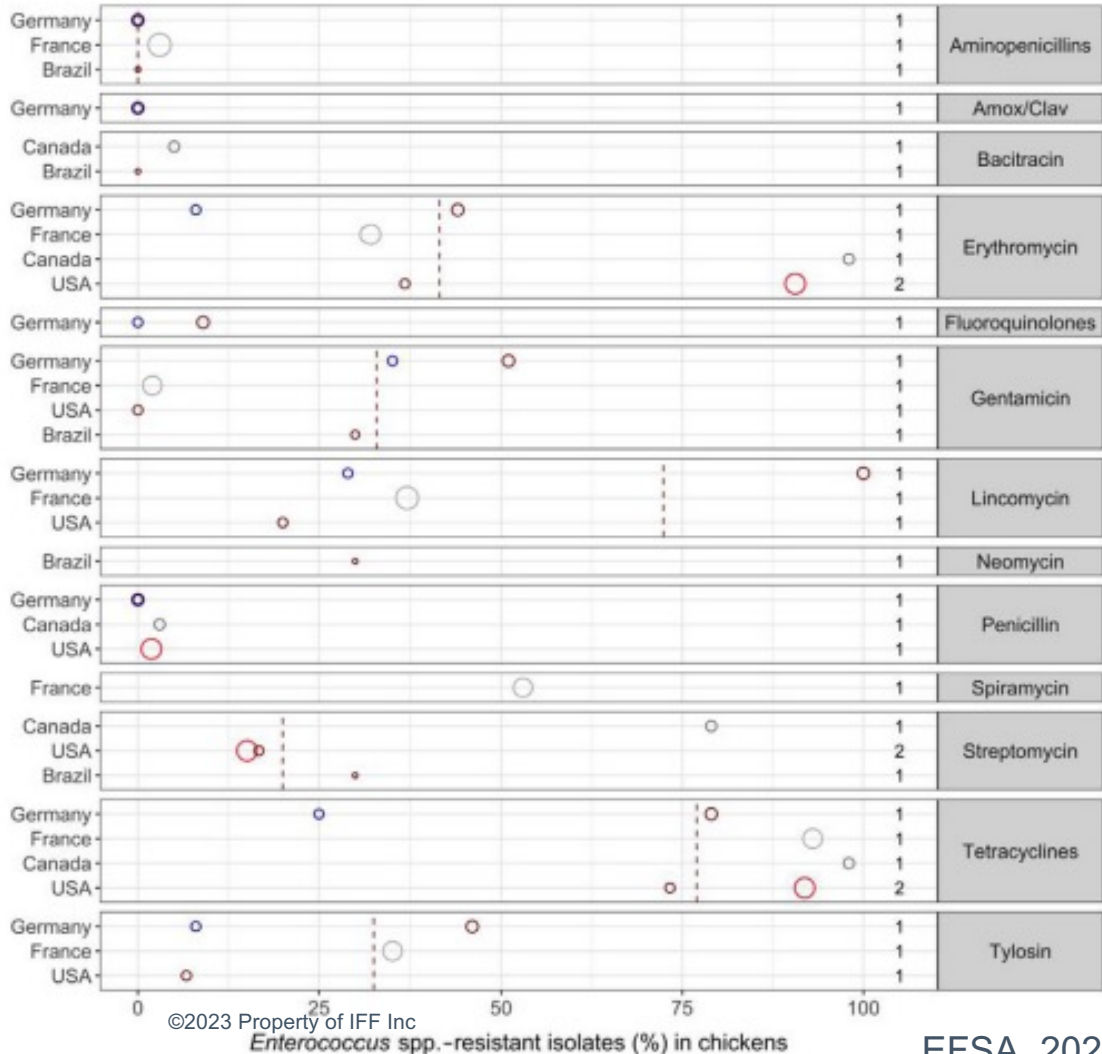
Evolution of scientific articles counts answering « *Enterococcus cecorum* » request PubMed database



# 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



At the species level

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

SCIENTIFIC OPINION



ADOPTED: 19 January 2022  
 doi: 10.2903/j.efsa.2022.7126

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

95%

TETRACYCLINE

75%

MLS

Macrolide/Lincosamide/Streptogramin



# HEALTH & PERFORMANCE GO HAND IN HAND

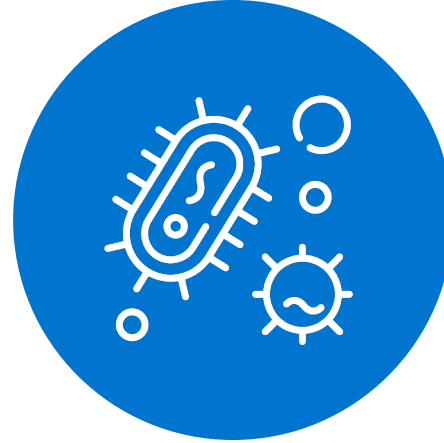
Accurately identify the issue and environmental contributions before determining the best course of preventative measures



## The Host

### *Identify host response*

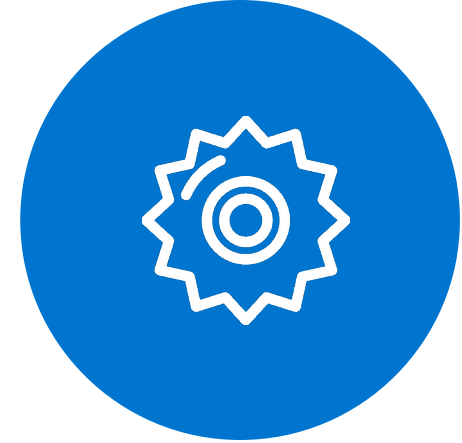
- Clinical/subclinical symptoms
- Physiological parameters (age, stress)
- Differentiate between conditions



## 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

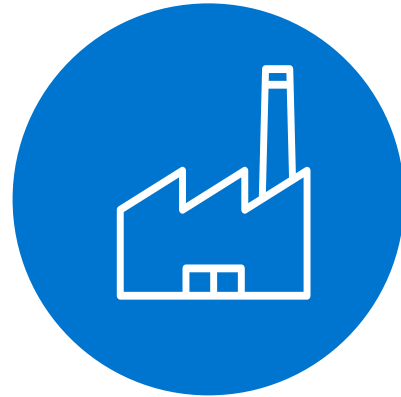
Antinutritional factors impact digestion – Leading to reduced animal performance



## 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



The bar contains four distinct icons from left to right:
 

- A word cloud featuring terms such as Proteomics, Transcriptomics, Metabolomics, Genomics, Epigenomics, and others.
- A colorful DNA double helix structure.
- A blue icon of a test tube and a petri dish.
- A green circular icon containing a white brain.

# EXOGENOUS ENZYMES PLAY A ROLL IN HEALTH & PERFORMANCE

Xylanase  
Amylase  
Protease



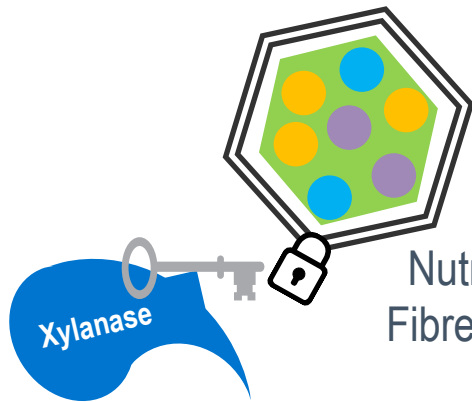
Short arabinose xylose sugars (AXOS)  
Prebiotic effect (SCFA production)

Improved digestion

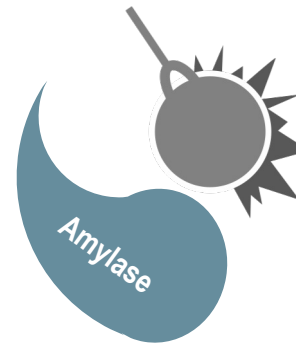
AMINO ACIDS

FAT

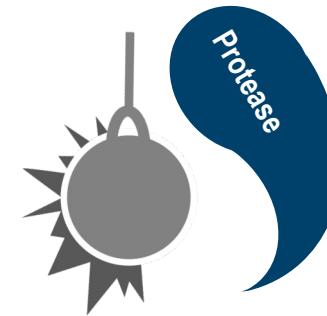
STARCH



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 practises contribute to disease output





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