



PARTNERS IN
PROGRESS

Nutritional Interventions to Mitigate Gut Health Problems

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Introduction

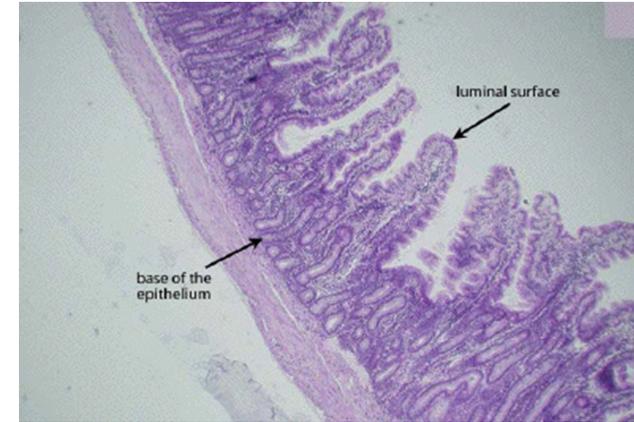
- Very wide-ranging topic
- A holistic approach is required
- Remember the GIT:
 - Must digest feed and absorb nutrients
 - Must prevent ingress of pathogens and antigens
- Focus on feed and nutritional solutions only
- Nutrient requirements of the GIT
- 10 strategies and interventions to modulate gut health

A holistic approach is recommended



Nutrients and the GIT

- Both the bird (enterocytes) and microbiota have specific requirements
- Requirements increase during gut health incidents
- Use 15 to 30% of O_2 , energy and protein



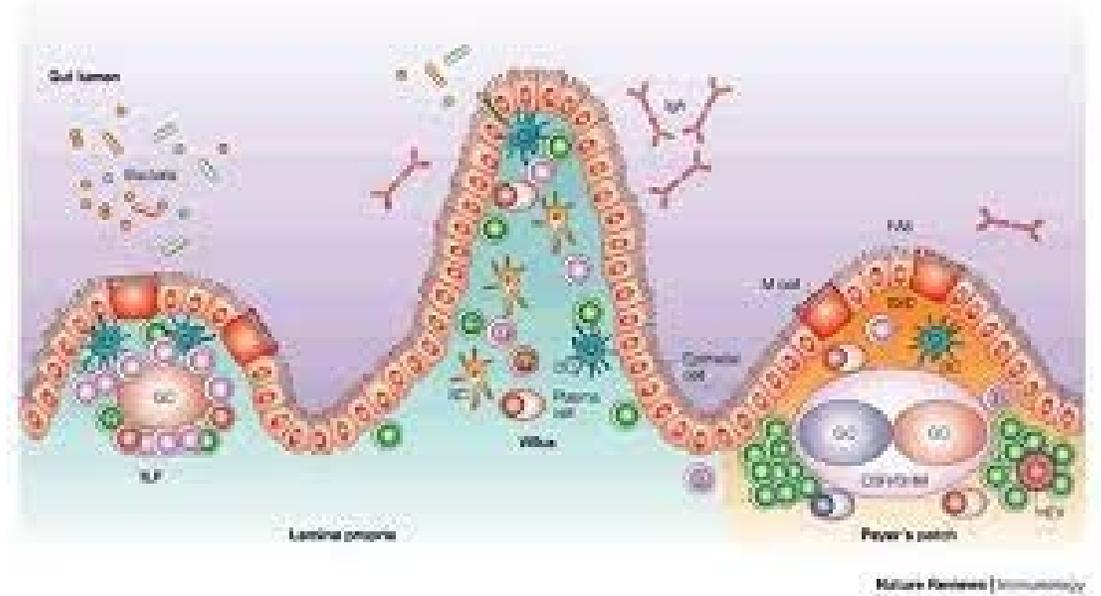
The chicken gut is a fermentation chamber



The gut is an important part of the immune system

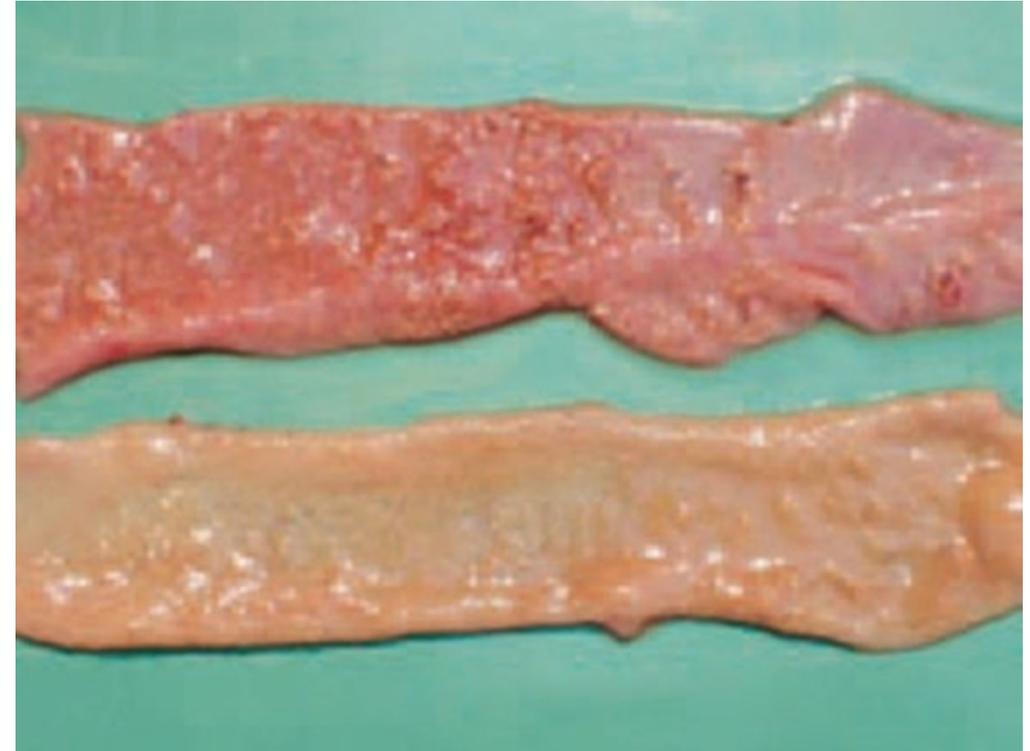
- Largest component of the immune system (GALT)
- Immune cells – insulin sensitive – require more glucose
- Demand for Thr, Val & Gly increases by 5%
- Intestines – first priority for nutrients.
- Enteric nutritional deficiencies unlikely

GALT – Gut-associated lymphoid tissue

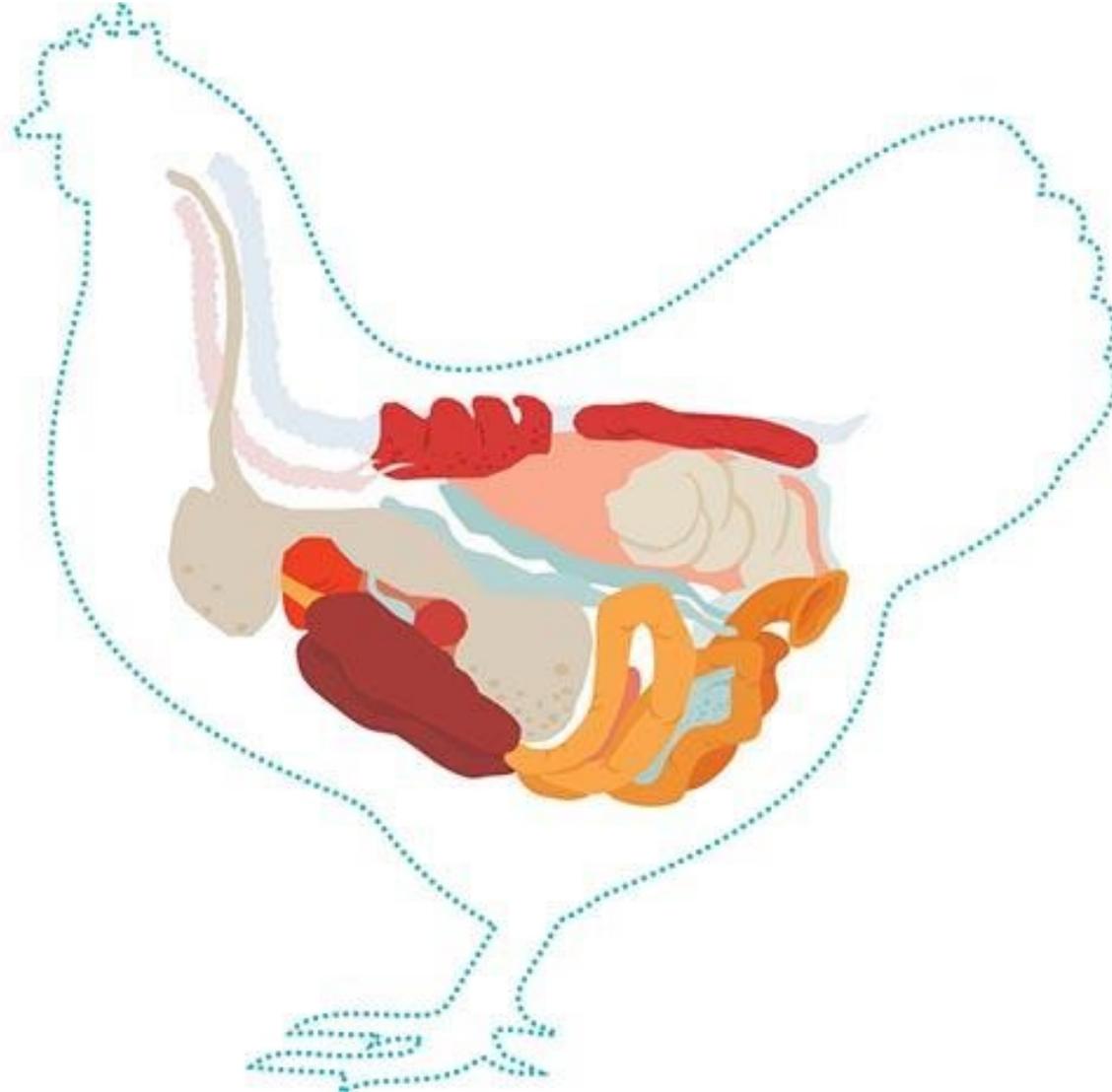


Inflammation is important

- Inflammation – core component of innate immunity.
- Inflammation impacts on:
 - Endogenous secretions
 - Tight junction effectiveness
 - Nutrient uptake – fat & micronutrients in particular

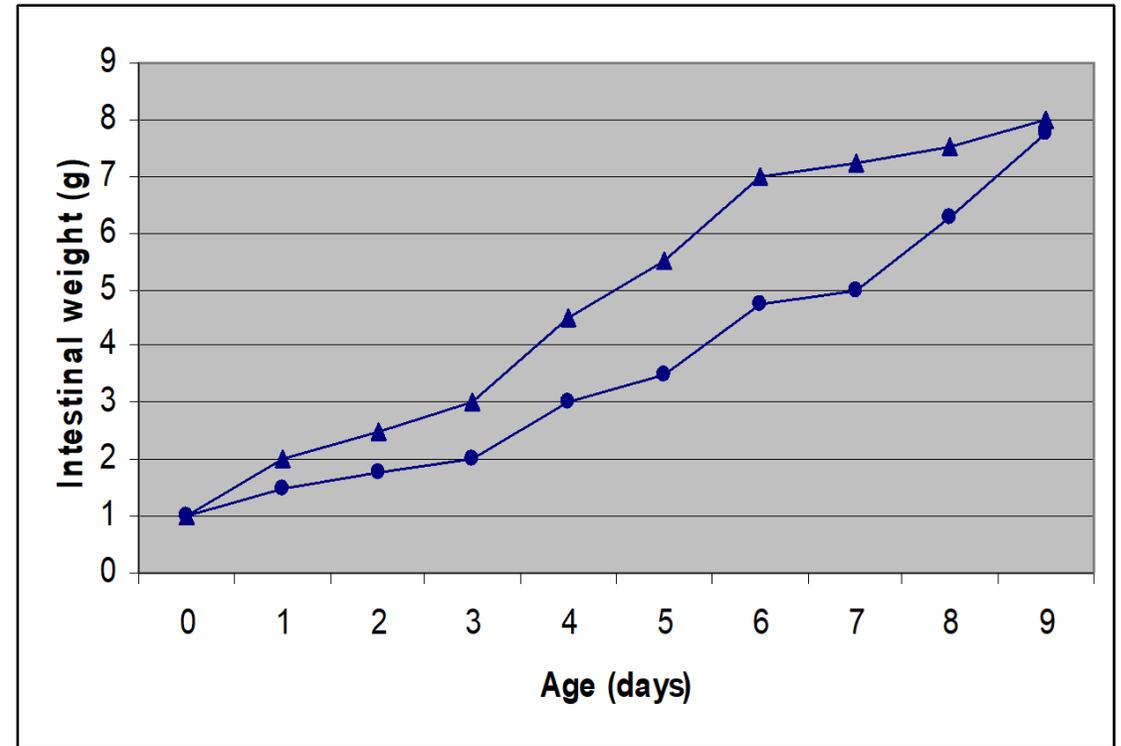


Nutritional strategies and interventions to improve gut health



#1: Enable early access to feed and water

- Easiest and most obvious intervention
- Achieve early intake of feed and water intake
- Stimulates physical and enzymatic development of GIT
- High protein diet – stimulates intestinal growth
- ‘Seed’ the microbiota with ‘beneficial’ bacteria



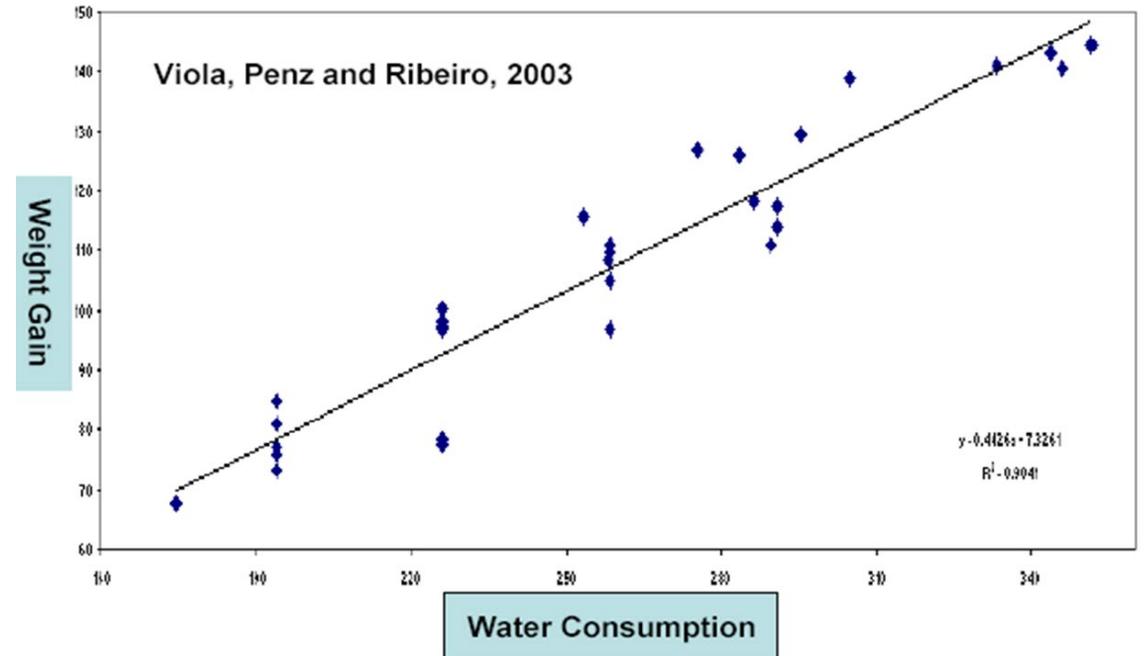
Fed (triangles)

Feed delayed (circles)

(Sklan, 2001)

Adequate water supply is essential

- Water is a central component of digestion
 - Digesta must contain correct proportion of moisture
 - Gut health depends on provision of quality water:
Free of pathogens (in front of the bird)
- Low levels of minerals (Fe stimulates *E. Coli*)
- Correct pH (bactericidal)



#2: Avoid fasting

- The opposite of achieving feed intake
 - Feed outage
 - Changes in feed
 - High stocking rates
 - Long dark periods
 - Thinning, feed withdrawal at processing
 - Poor brooding
 - Stress (particularly heat stress)



Fasting negatively impacts digestion and gut health

- Triggers reverse peristalsis
 - Uric acid to caecum (N for Clostridia)
 - Microbes from caeca to intestine (dysbacteriosis)
- Has impact on tight junctions:
 - Enterocytes - sensitive to energy & protein restriction
 - Reduced barrier function - classical “leaky gut”

#3 Develop the Gizzard

A well-functioning gizzard:

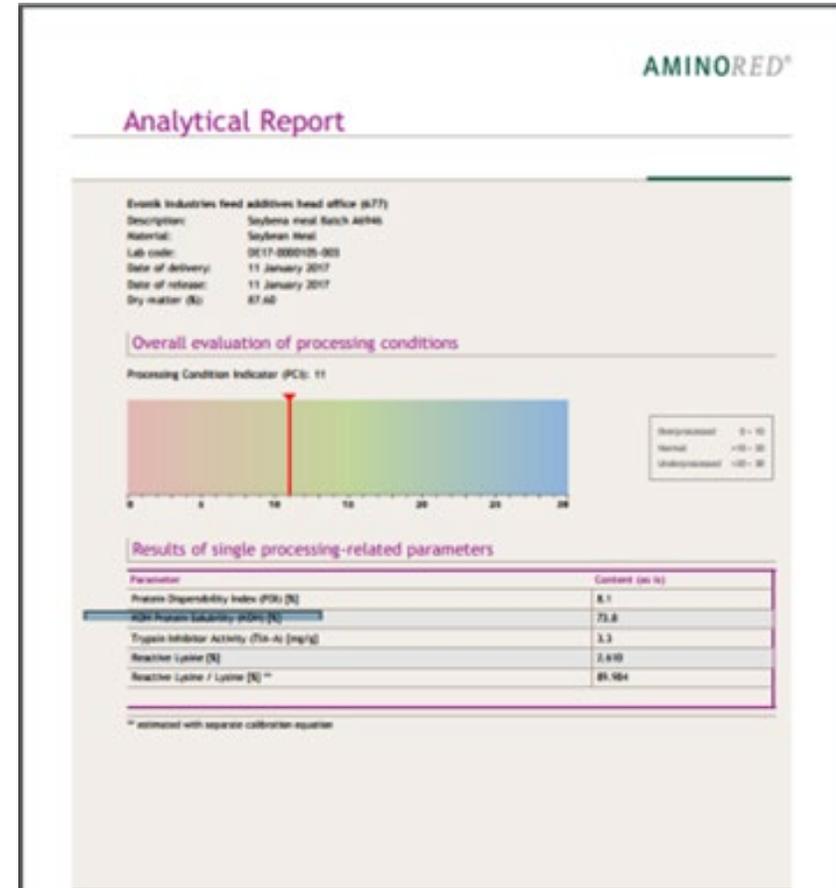
- Plays role in intake regulation
- Hinders feed overconsumption
- Lowers pH
- Direct impact on feed digestibility
- Finer particles – increased nutrient uptake
- Coarser particles – finer grind
- Use structured ingredient; whole grain, fibre



(Jimenez-Moreno et al., 2015)

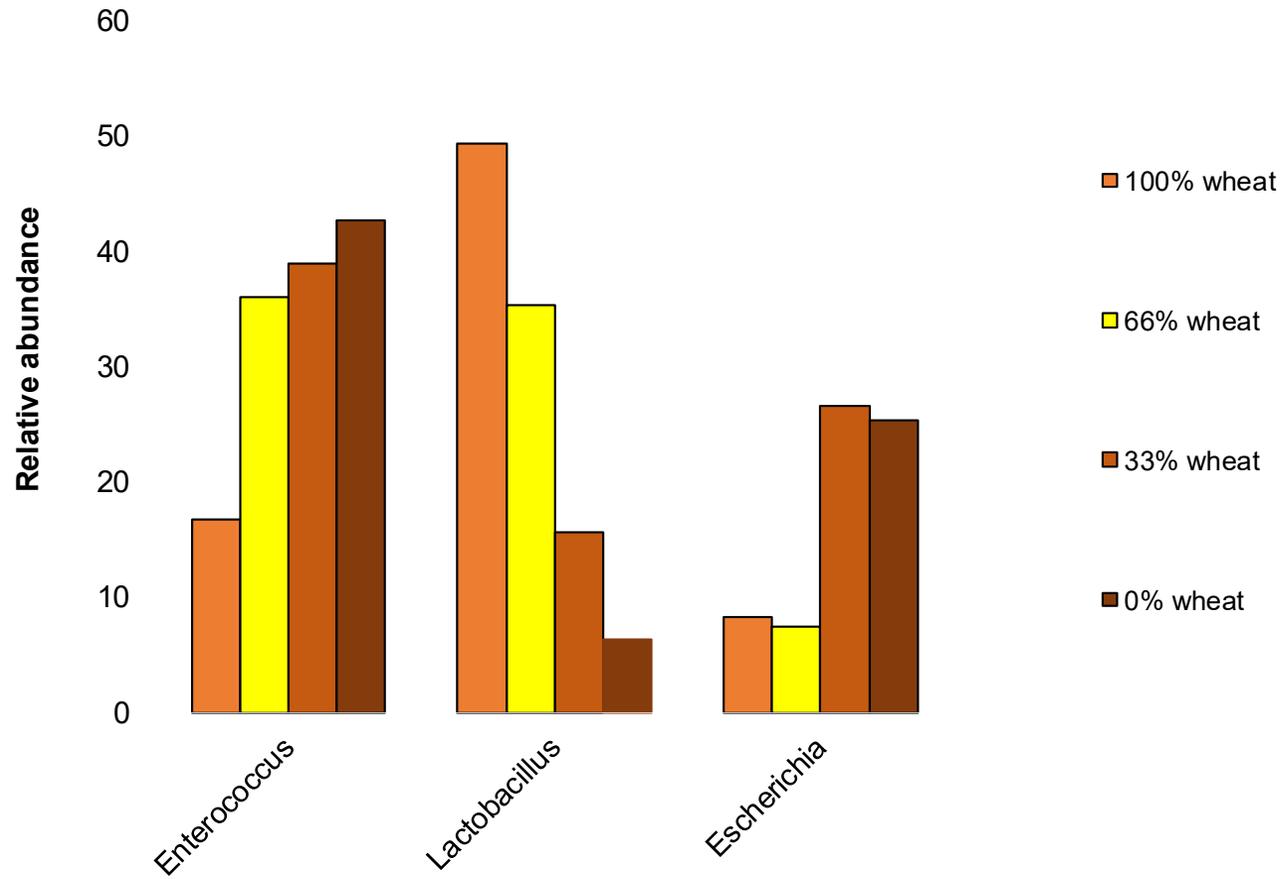
#4: Manage ingredients and consistency

- Chick – diminished ability to digest diet
- Feed quality – should be excellent
 - High biological quality (taste, smell, moisture)
 - Manage ingredients (ANF, processing, screening)
 - Correct granulometry (grist & pellet)
- Control variability (multiplicative not additive)
- Use appropriate additives (efficacious and cost-effective)



However good you think you are –try harder!

Wheat/rye influences caecal microbiota



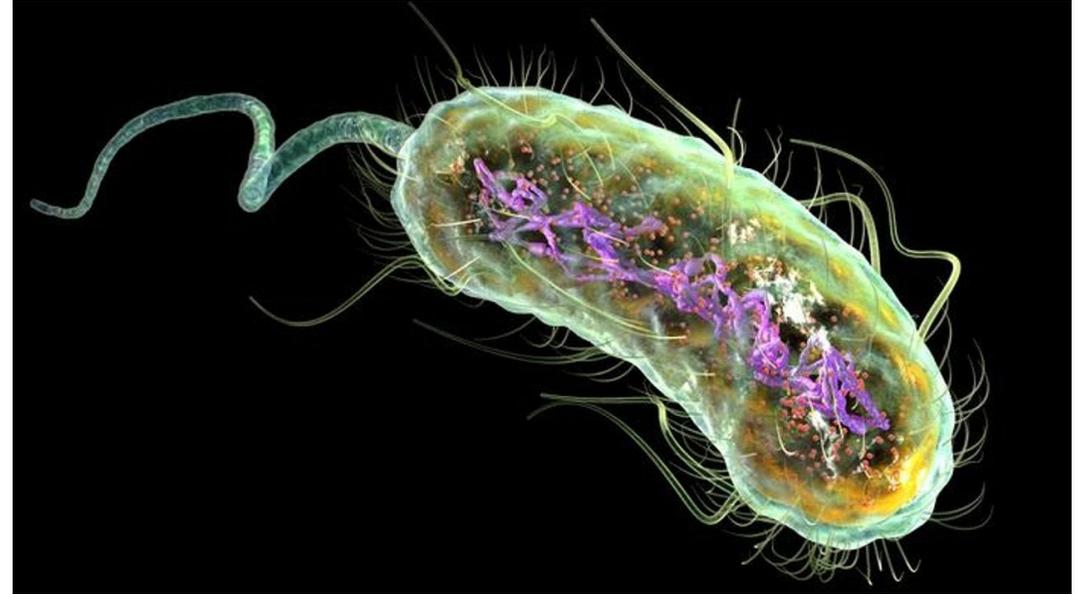
#5: Manage protein supply



Google's DeepMind Alpha Fold: AI determines protein structure

Protein influences the gut and its microflora

- Gut responds to high protein starter diets.
- Microflora – specific requirements:
 - *E. Coli* – synthesis of all AA - only usable sugar and minerals required.
 - Lactobacilli complex AA requirement - use 3 - 6 % of AA.
 - Clostridia – particularly responsive to Lys.



Carry over from starter to end

Dig Lysine (g/kg)	Body Weight 10 d (g)	Intestine Length 10 d (cm)	Body Weight 39 d (g)	FCR 39 d
11.9	157 ^c	106 ^b	1956 ^b	1.80
12.8	169 ^b	107 ^b	1985 ^b	1.79
13.7	190 ^a	112 ^a	2094 ^a	1.74

Protein

Yet – surplus has severe consequences:

- Negative effect on gut health
- Reduces efficiency of utilisation (makes production less sustainable)
- Direct impact on the environment



Protein influences the composition of microbiota

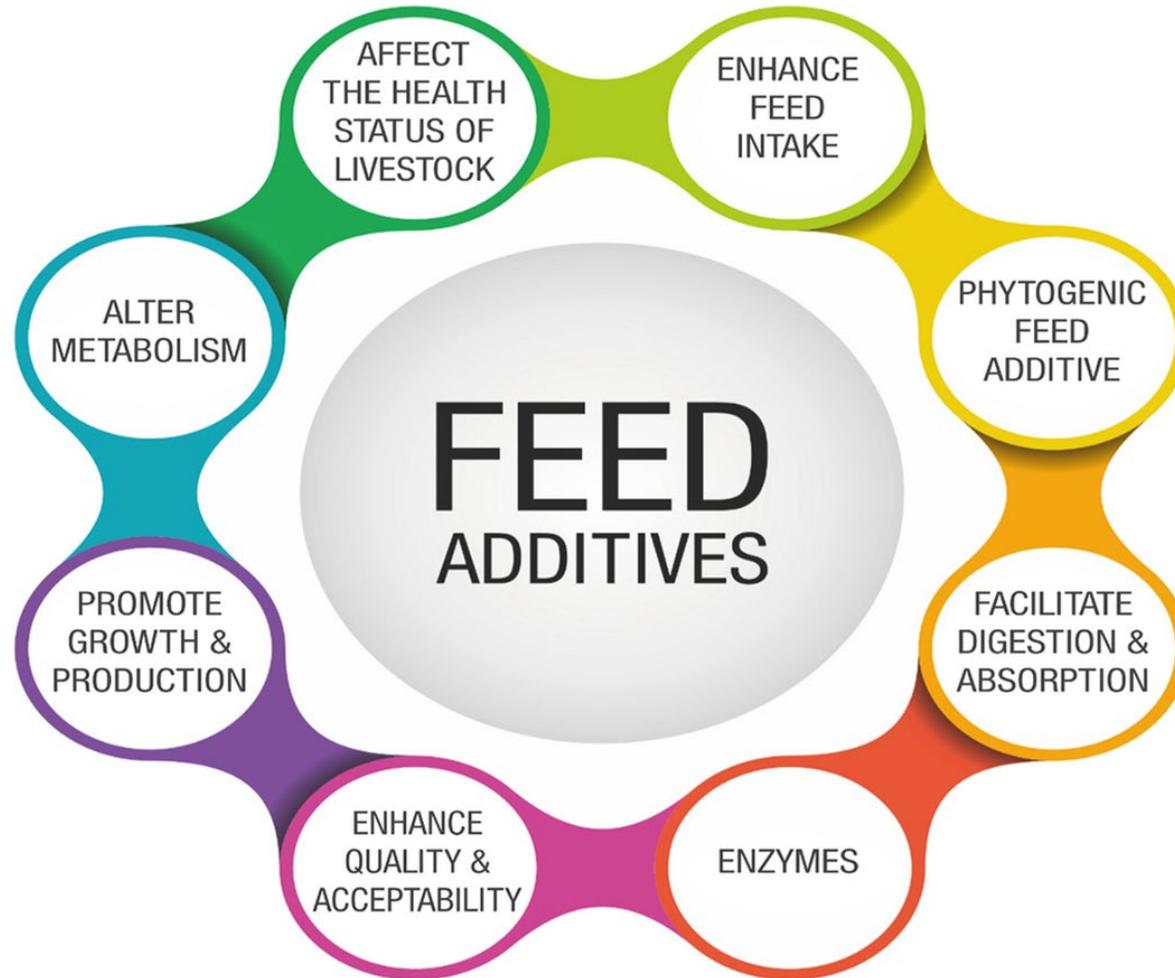
Protein bypassing the small intestine

- May originate from:
 - Resistant or surplus protein of dietary origin
 - Microbial protein
 - Endogenous protein & intestinal damage
- Fermentation - harmful metabolites
- Stimulates proteolytic bacteria – principally *C. perfringens*



Clostridium perfringens is large rectangular gram-positive bacilli with rounded or truncated ends (Microbe Notes, 2020).

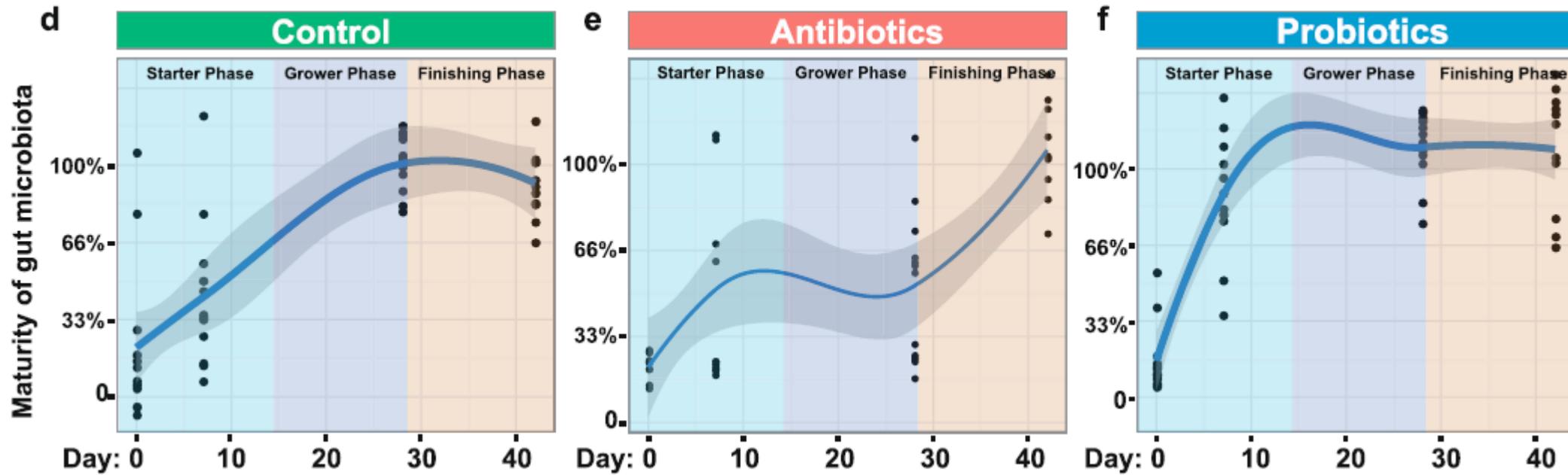
6 Use additives



Additives have modifying properties

- Additives replace antibiotics and/or enhance gut health
- AGP's masked imbalances in microflora
- Still don't fully understand their mode of action (Broom, 2018)
- Additives – mostly modify the microbiota
 - Ionophores, pro-biotics, pre-biotics, enzymes
- Some modify enterocytes
 - Betaine, nucleotides, enzymes, VFA's

Additives alter gut microbiota



#7 Use plant extracts (phytogenics)

- Essential oil extracted from plants (flowers, leaves, roots, fruit)
- Sum of constituent volatiles
- 2 – 3 compounds account for 80% of any mixture in a plant
- Phenols (thymol, carvacrol, β -cymene) found in oregano
- Other plants – garlic, turmeric, thyme, black pepper



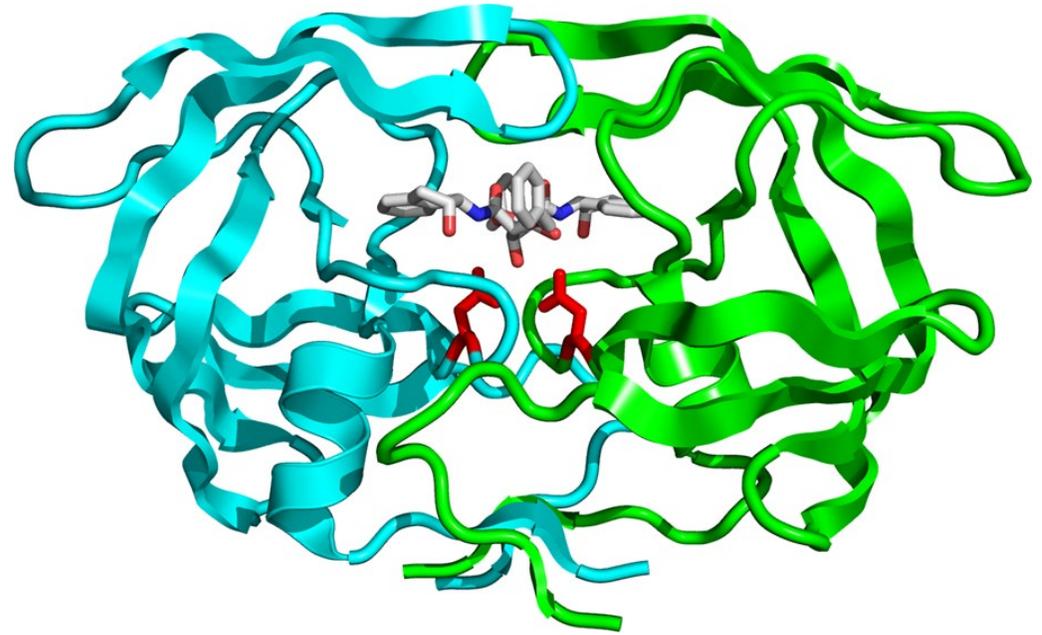
Plant extracts have diverse properties

- Specific mechanisms - better understood and refined:
 - Antibacterial properties – reduce pathogenic load
 - Improve the body's antioxidative stability
 - Improve microbial composition and metabolic function (Zhu et al., 2019)
 - Support the host immune system
 - Reduce inflammation, and support tight junctions
 - Enhance nutrient uptake
 - Improve performance

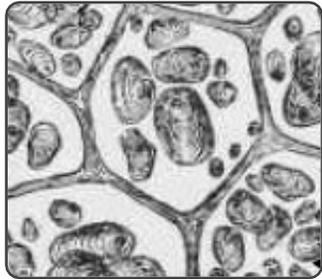


#8 Use enzymes - they are very effective

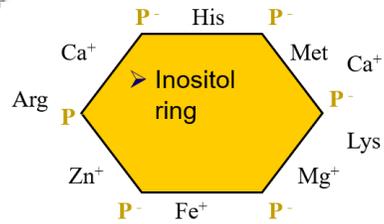
- Perhaps the most effective tool at our disposal:
 - Enhance digestibility
 - Reduce viscosity of the digesta (NSP's)
 - Have a prebiotic effect (butyrate production)
 - Deprive microbiota of nutrients
 - Change bacterial species distribution
 - Inactivate anti-nutrients
 - Modify gut structure (reduce inflammation/stress)



Complimentary Enzymes and Protein



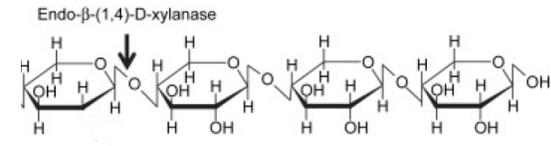
Xylanase:
Cage Effect



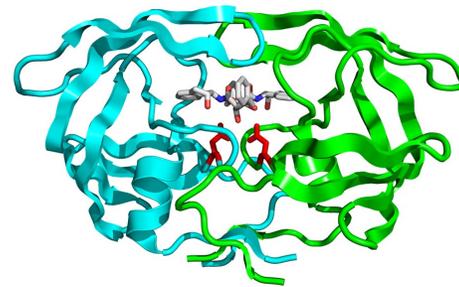
Phytase:
Electrostatic bonds



β Mannase, phytase:
- Reduce inflammation
- Prevent endogenous loss



Xylanase, pectinase:
Reduce viscosity

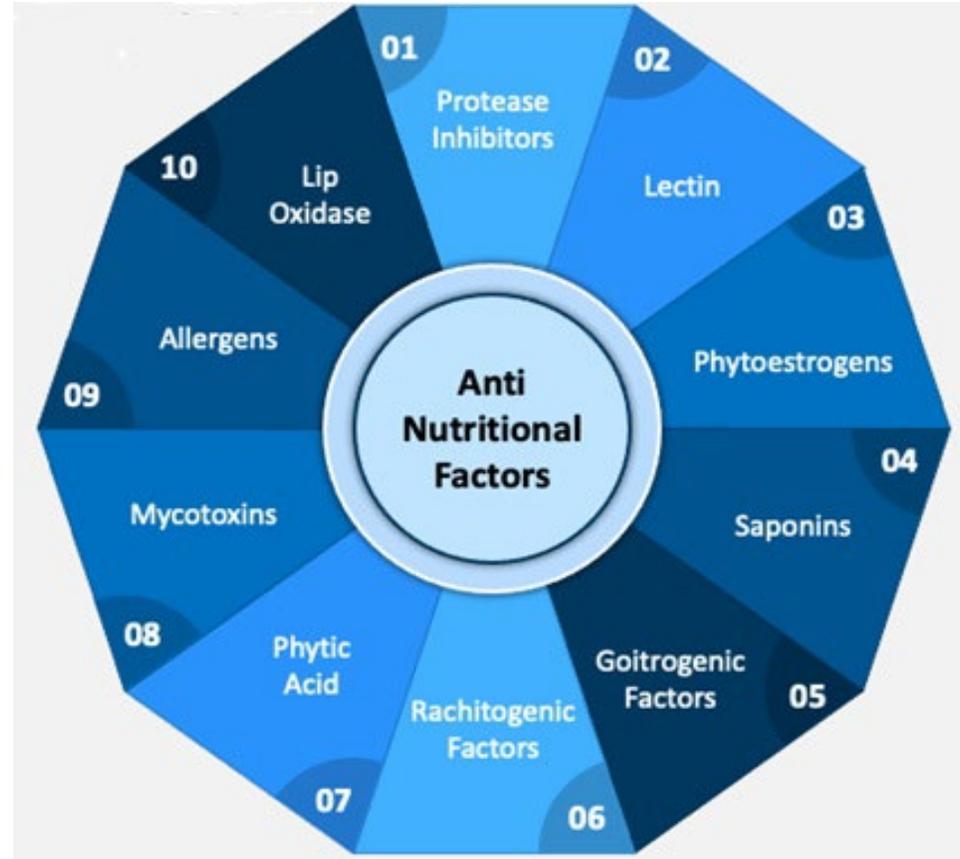


Protease:
Breaks peptide bonds

9 Control Anti-Nutritional Factors

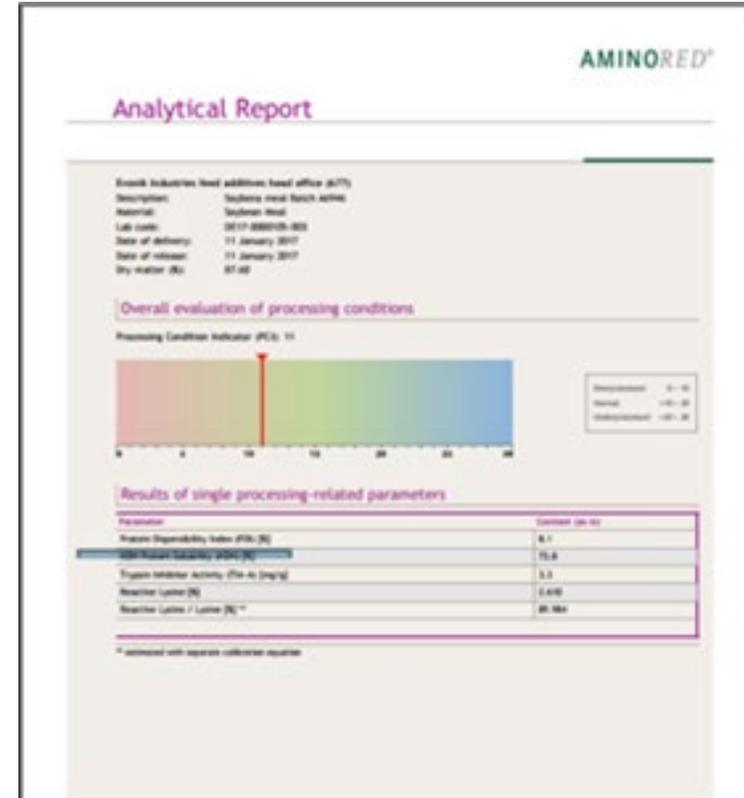
There are a number of classes of ANF to consider:

- Food proteins and non-starch polysaccharides (NSP)
- Metabolites - mycotoxins, gizzerozene
- Invading pathogens
- GIT microbiota and the toxins that they secrete



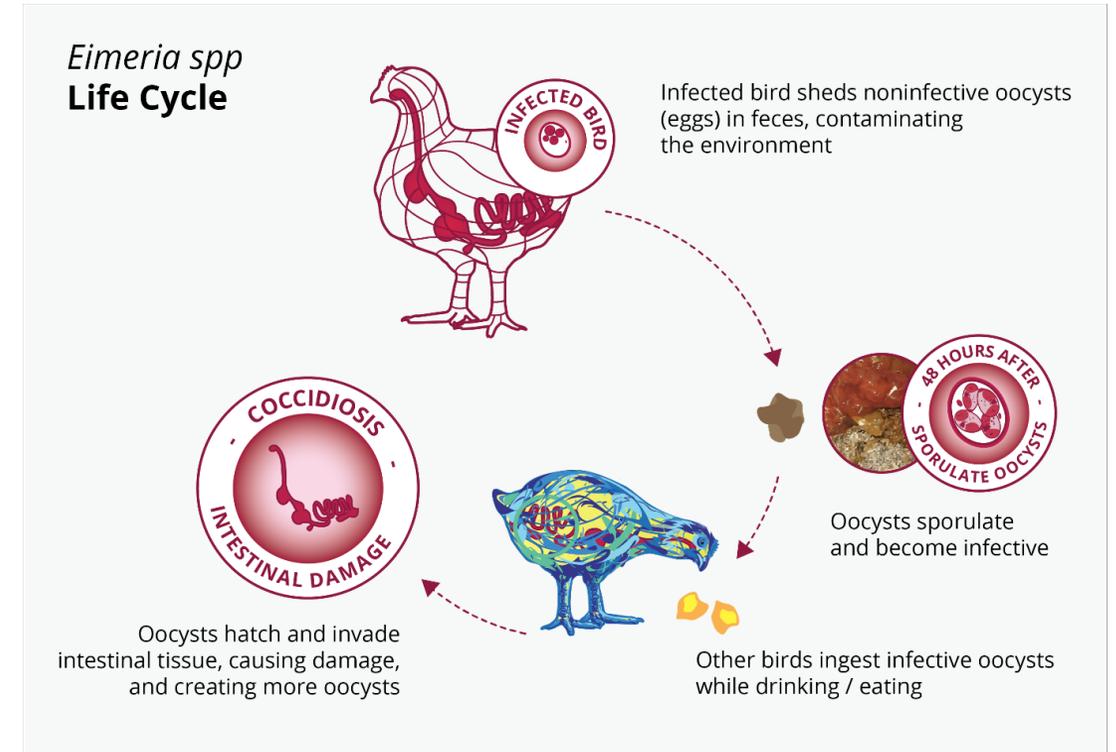
Control ANFs

- Prevent rather than cure
- ANF may be reduced by managing ingredients
 - Select the correct ingredients (corn versus wheat)
 - Screen and clean incoming product (broken and moldy grain)
 - Ensure heat processing is correct (protein sources)
- Deactivate ANF's using endogenous enzymes
- Some ANFs are heat labile and refractory to enzymes



#10 Control coccidiosis

- Normally considered to be a veterinary matter
- But – control often falls into nutritionists' hands
- Cocci - damaged gut epithelium
- Increased supply of endogenous protein
- Exacerbates necrotic enteritis (NE).
- Simple, effective programs required.



Ionophores are used in coccidiosis control

- Removal of ionophores – a real challenge
- Apart from cocci control - many have antibacterial activity
- Considered as ‘feed additives’ in Europe, ‘antibiotics’ in the USA
- Of no importance in human medicine
- Hydrophobic ionophores penetrate Gram-positive bacteria
- Interfering with ion transport (Kadykalo et al., 2018)

Some Take Home Messages



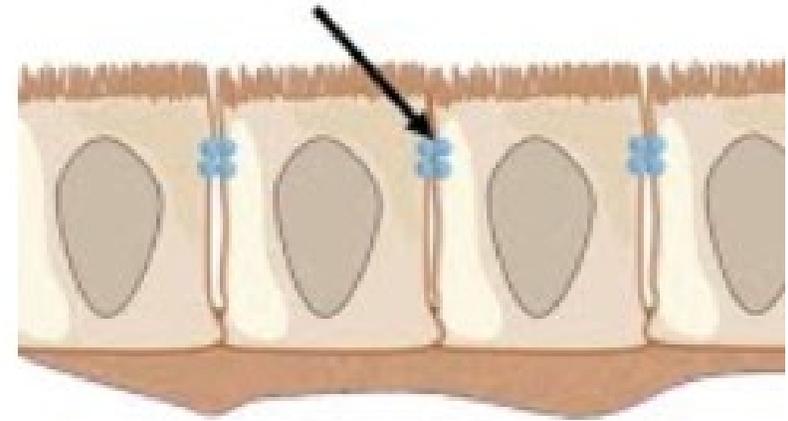
Gut-friendly diets and feeding

- Mostly – only prevent GIT issues; can't fix them
- Meet nutrient requirements of both GIT & bacteria
- Reduce level of undigested material
- Select ingredients and additives judiciously
- Aspire to minimise the content of ANF
- Enzymes will likely play a key role



Gut-friendly diets and feeding

- Achieve early intake of high protein diets.
- Maintain gizzard function (particles, fibre).
- Maintain constant GIT chemistry (pH, substrates)
- “Seed” the microbiota with beneficial’s.
- Manage inflammation & tight junctions.



“Good gut health
is the best growth promoter”



THANK YOU!