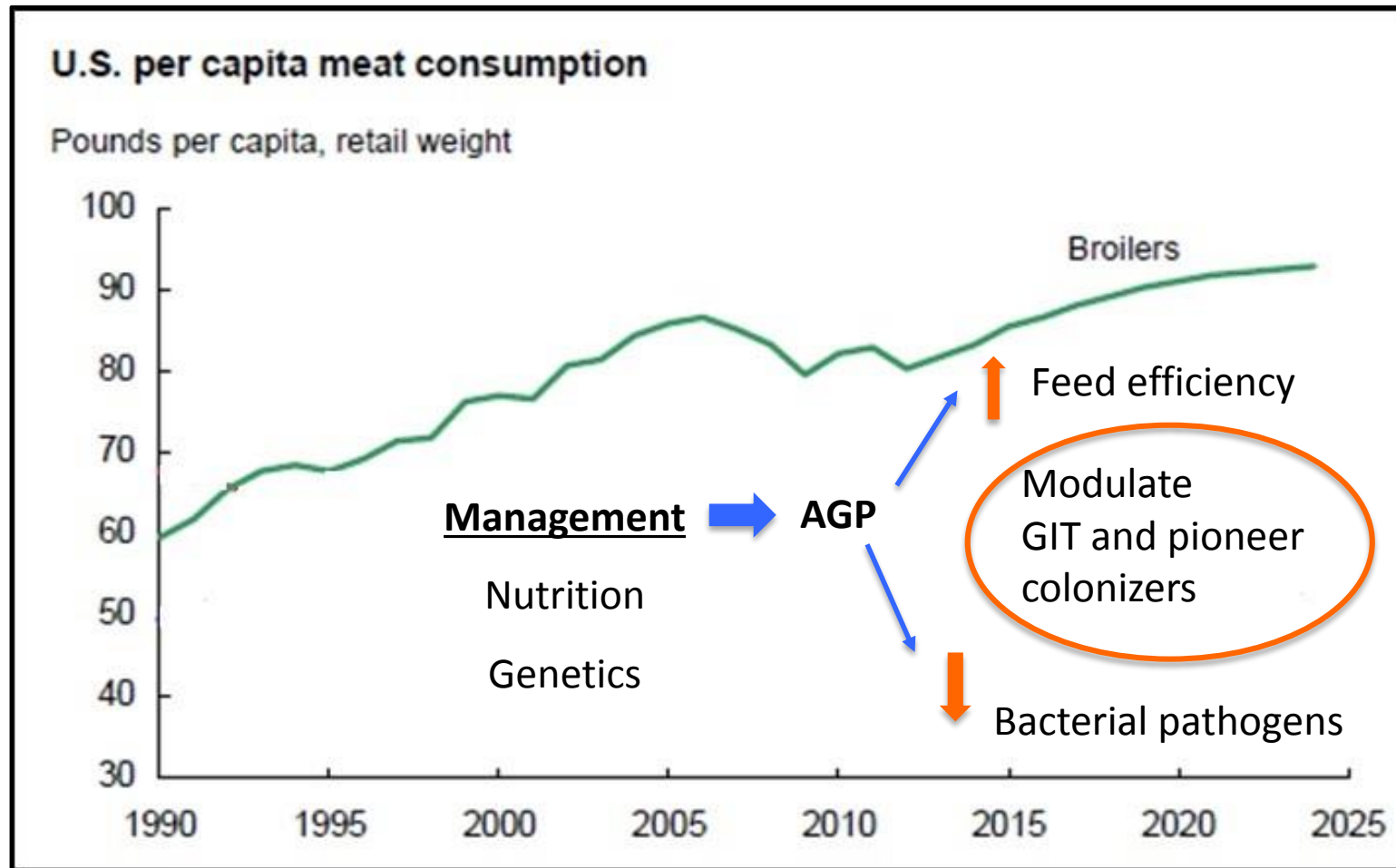


Opportunistic Diseases

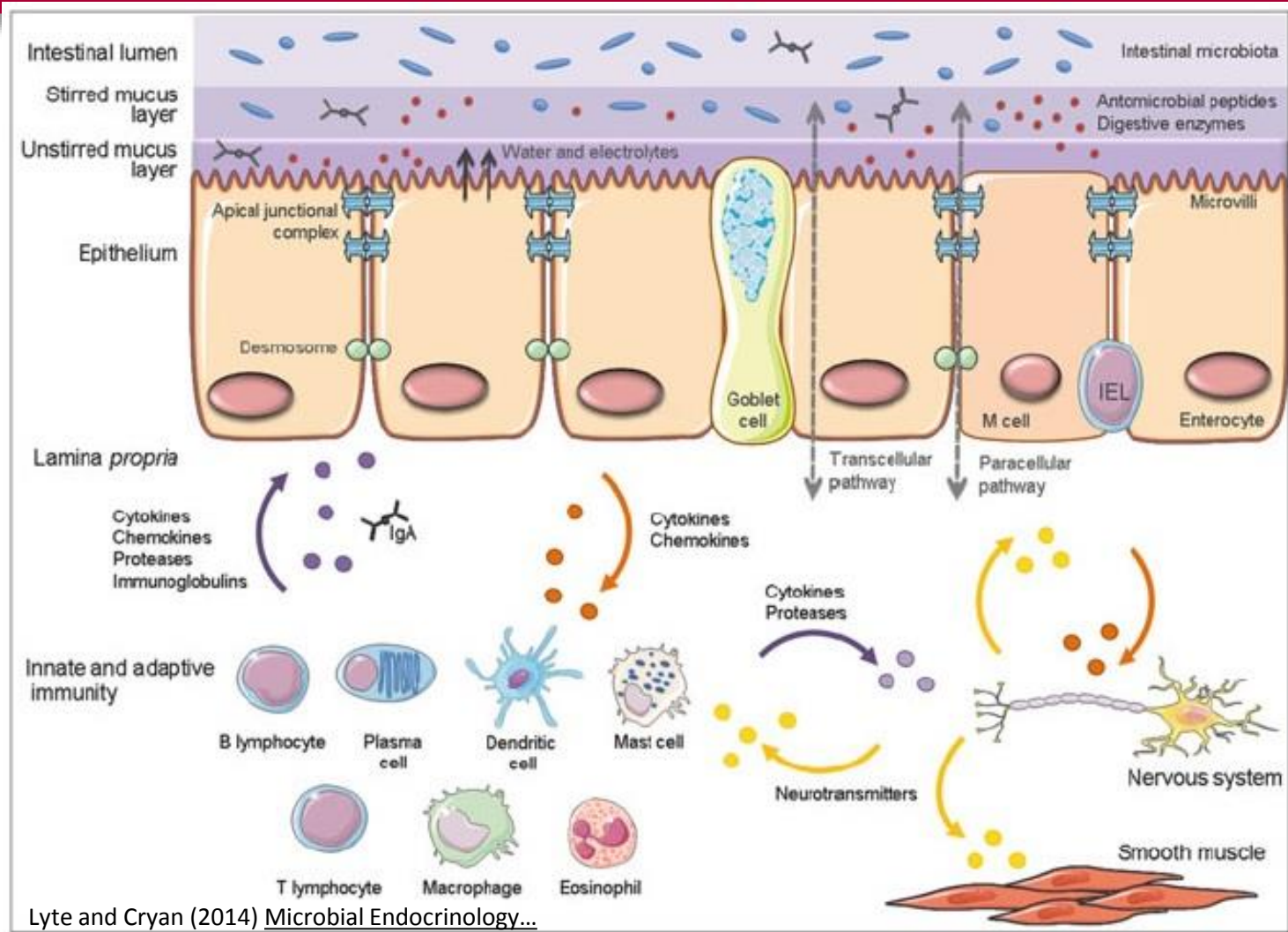
Lisa Bielke and many others

How does industry meet consumer needs?



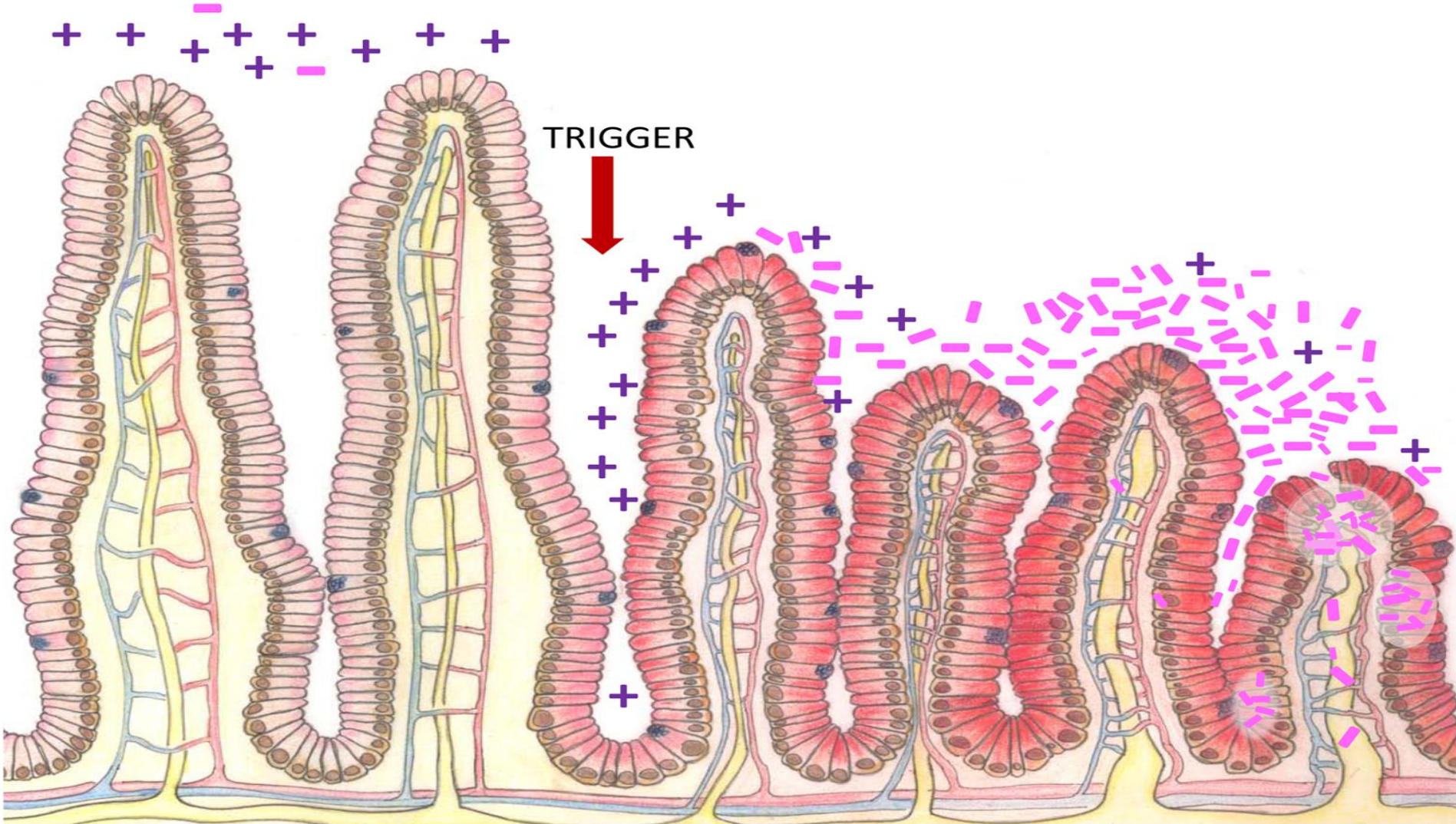
USDA Long-term Projections, 2015

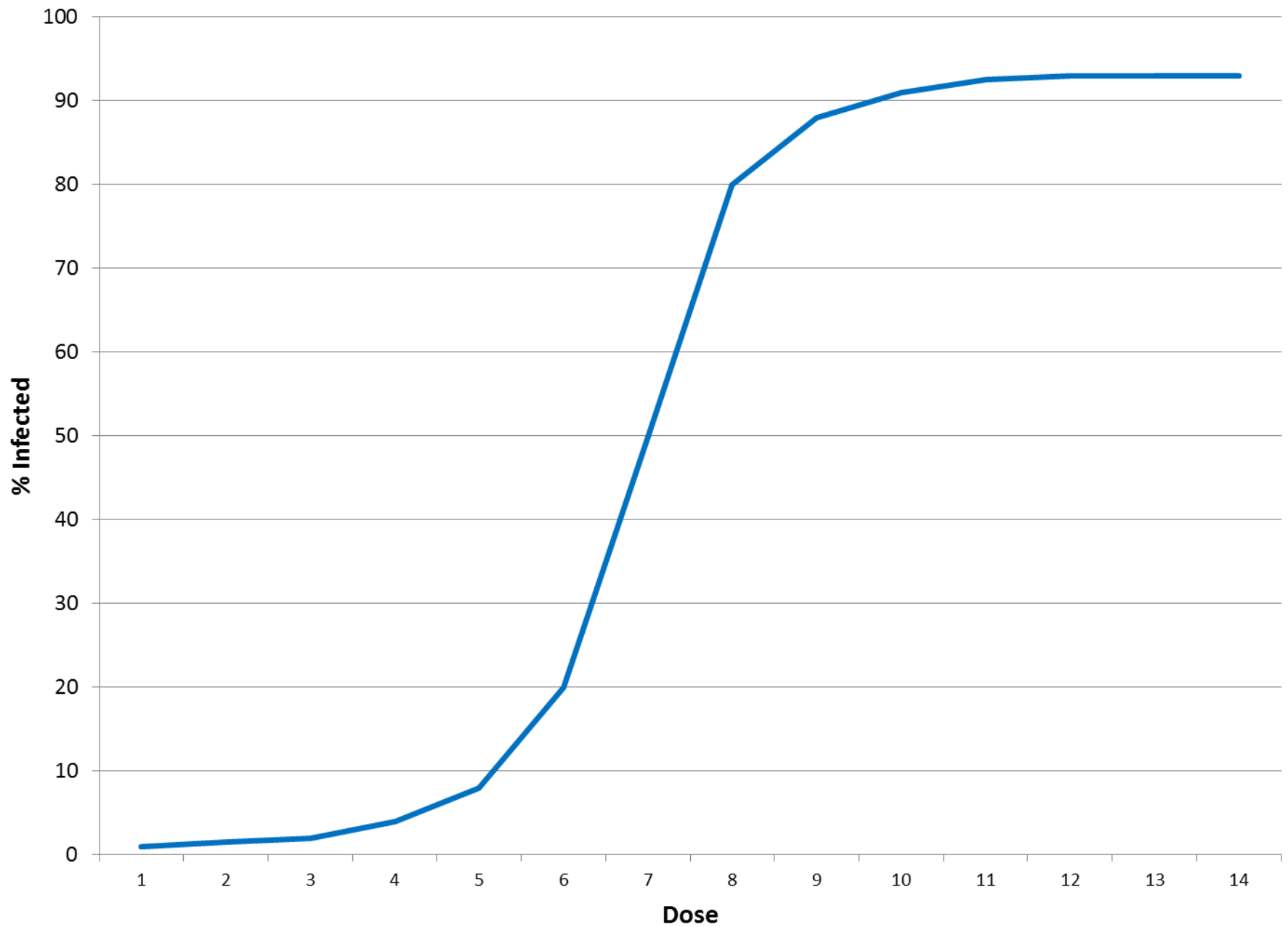
Intestinal Barrier Function

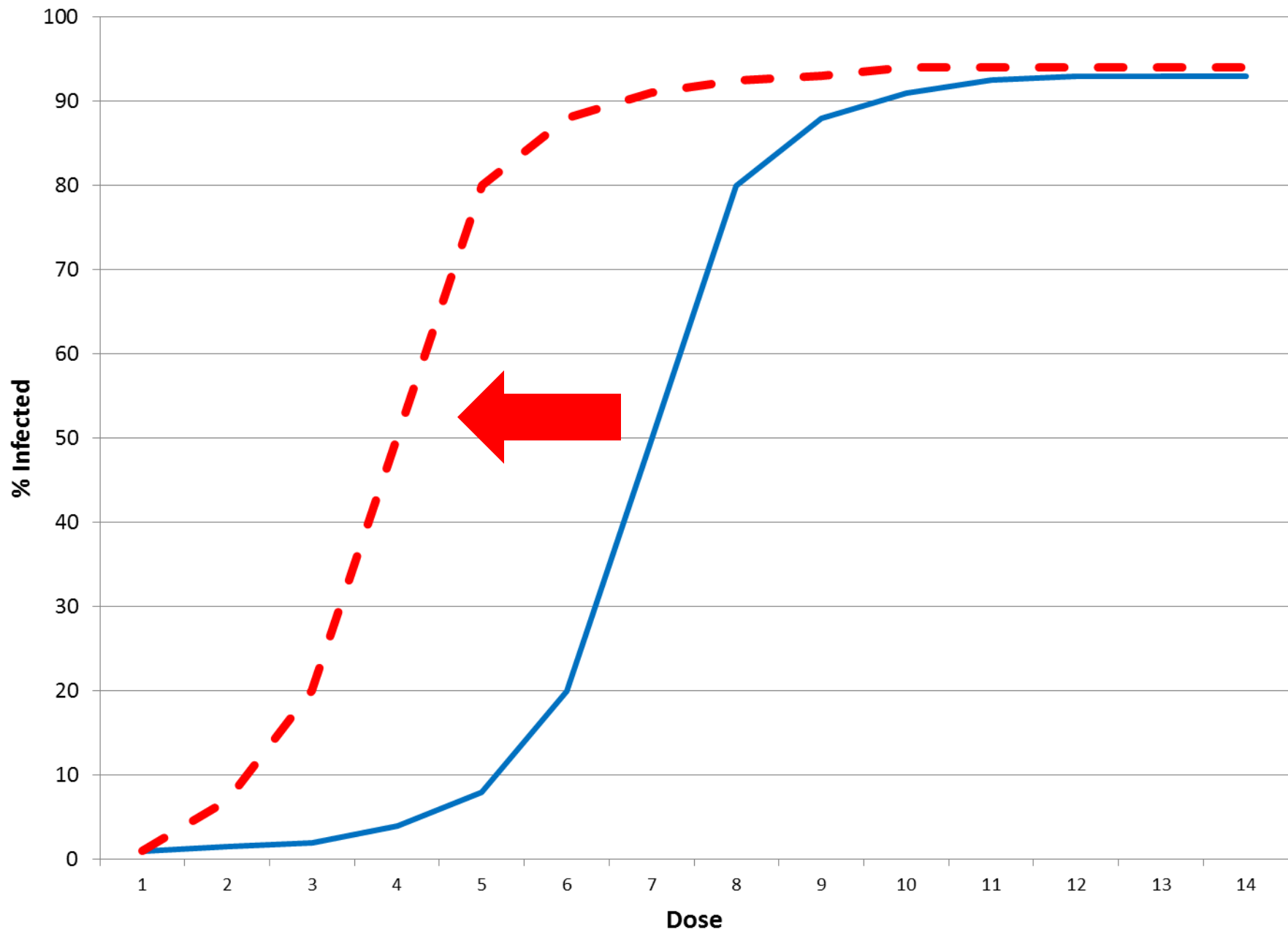


Lyte and Cryan (2014) *Microbial Endocrinology...*

Loss of Barrier Function

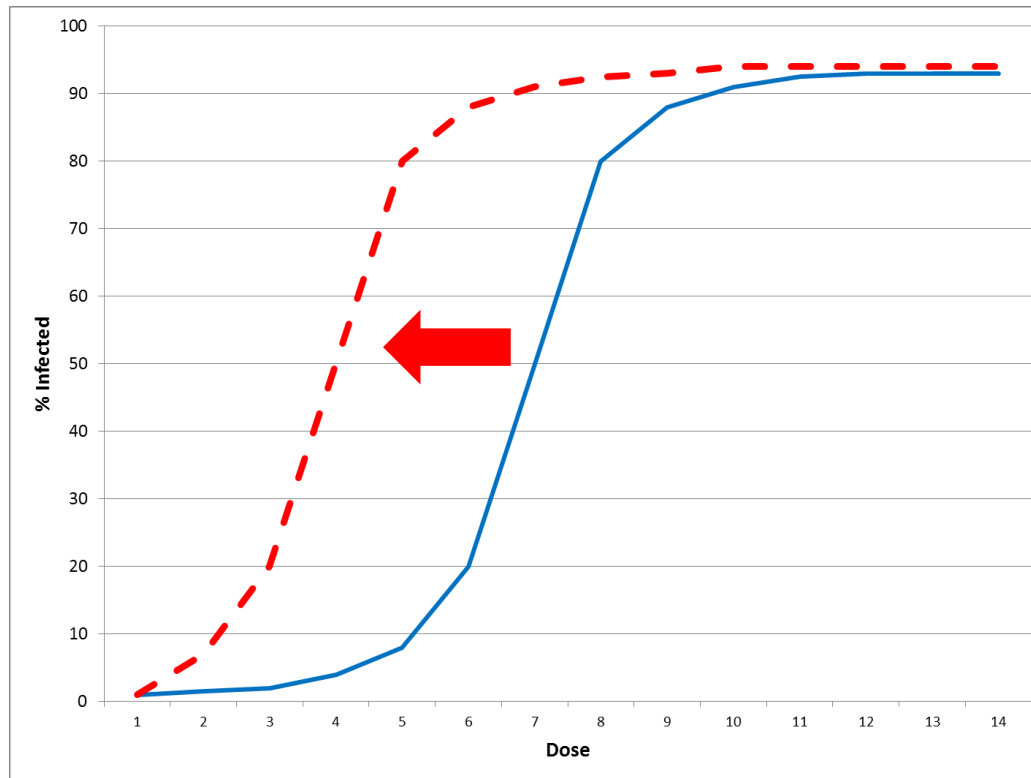






Consequences of Chronic GI Inflammation

- Problems most often occur as a result of too much, rather than too little, control



The GIT is in a constant state of controlled inflammation

Consequences of Chronic GI Inflammation

- Human Diseases
 - Inflammatory Bowel Disease
 - Crohns Disease
 - Ulcerative Colitis
 - Other inflammation-related diseases
- Poultry
 - Decreased overall performance
 - Increased feed conversion ratio
 - Disease susceptibility

Eubiosis (balanced)

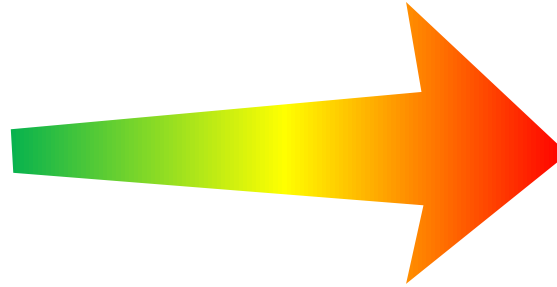
Symbiotic co-
existence of host
& microflora

Beneficial

Dysbiosis (unbalanced)

Diseased interaction
between host and
microflora

Pathogenic



- Protected mucus membrane
- Competitive exclusion
- Balanced stimulation of immune system
- Nutritional benefits

- Damaged epithelium
- Toxins
- Unbalanced increased immune response
- Increased cellular turnover
- Decreased nutrient absorption

Adapted from: M. Mohnl (2007) www.Engormix.com

Opportunistic Infections

- Necrotic enteritis
- Dysbiosis
- Not just GIT:
 - gangrenous dermatitis
 - enterococcal spondylitis (kinky back)
 - bacterial chondronecrosis with osteomyelitis (BCO)

Necrotic Enteritis (NE)

- Causative Agent: *Clostridium perfringens* (CP) Type A strains
 - Healthy birds have natural population of CP in intestine
 - Overgrowth of CP due to compromised gut environment induces NE



Score 1

Score 2



Score 3

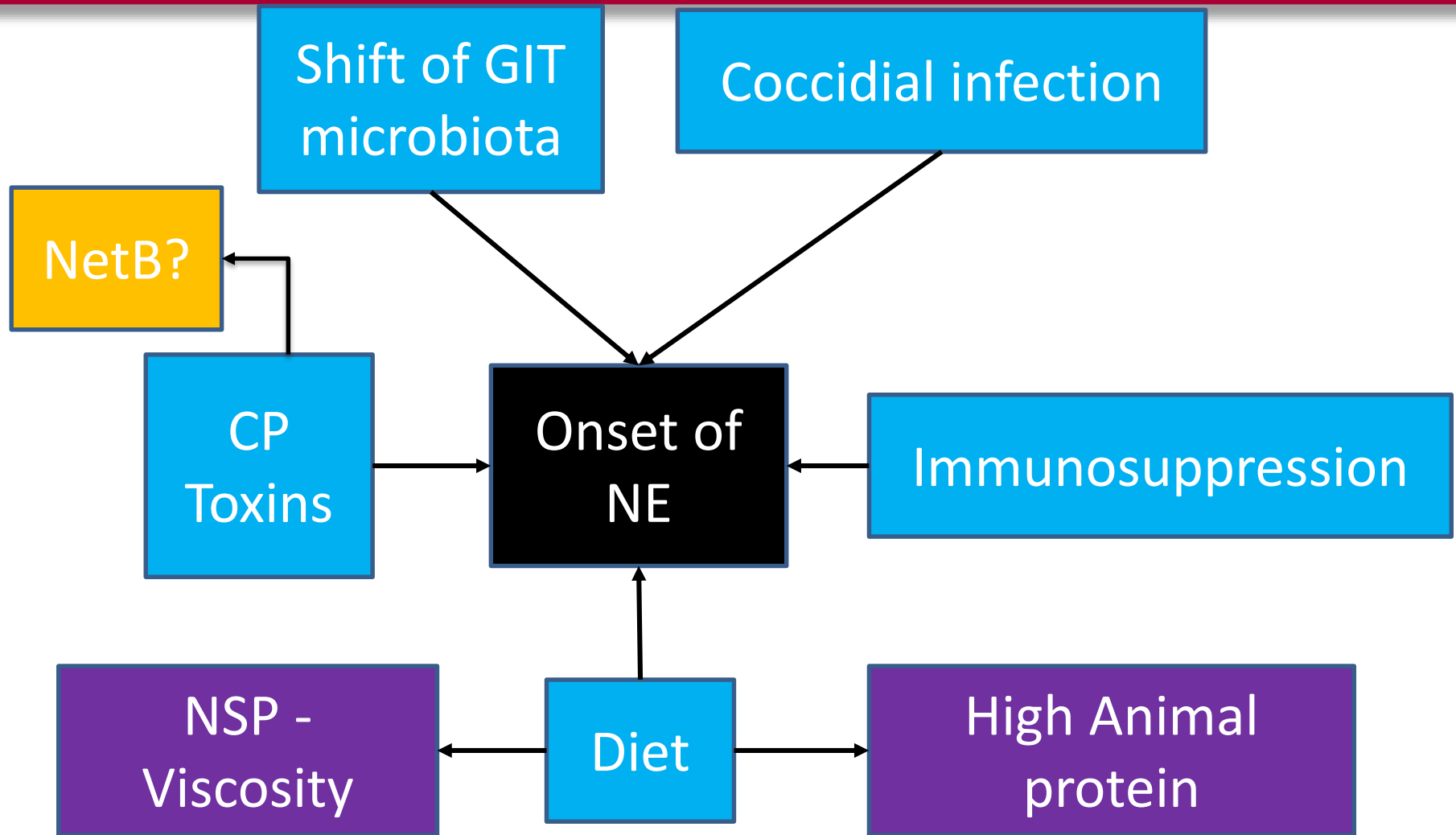


Score 4

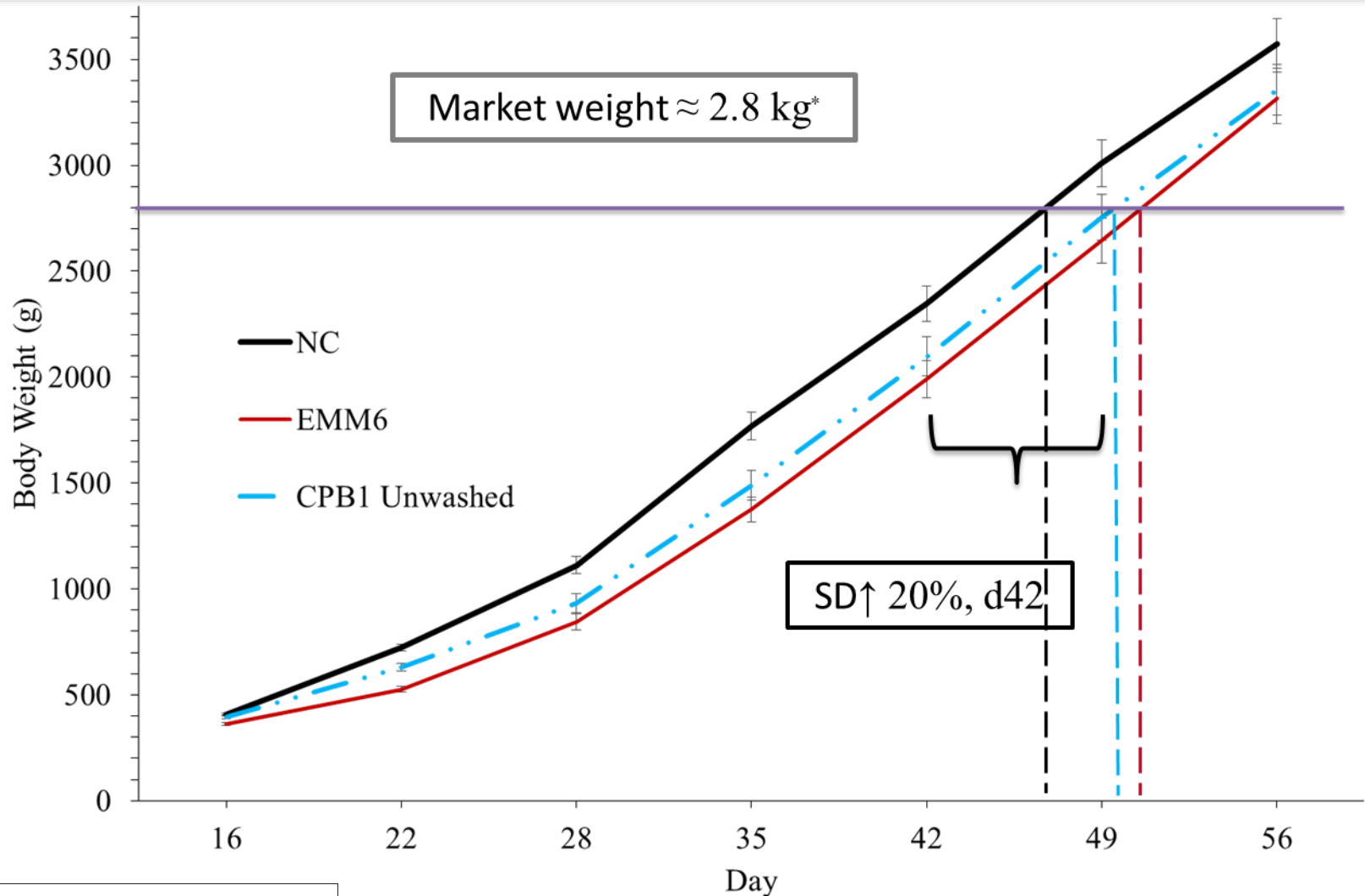


<http://www.poultryworld.net/Nutrition/Articles/2016/2/Dietary-treatments-for-major-poultry-diseases-2764118W/#>

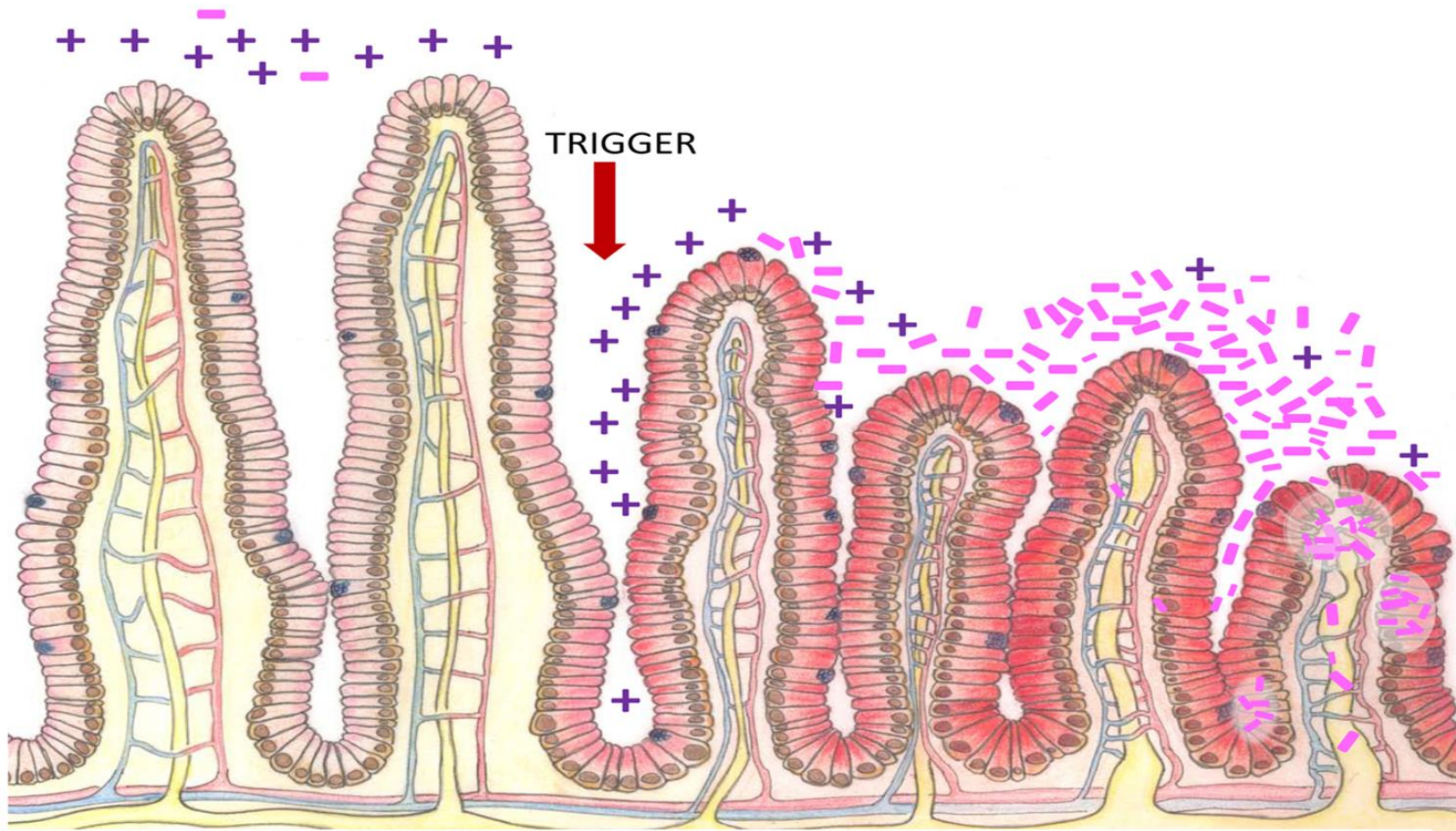
How a compromised gut creates NE



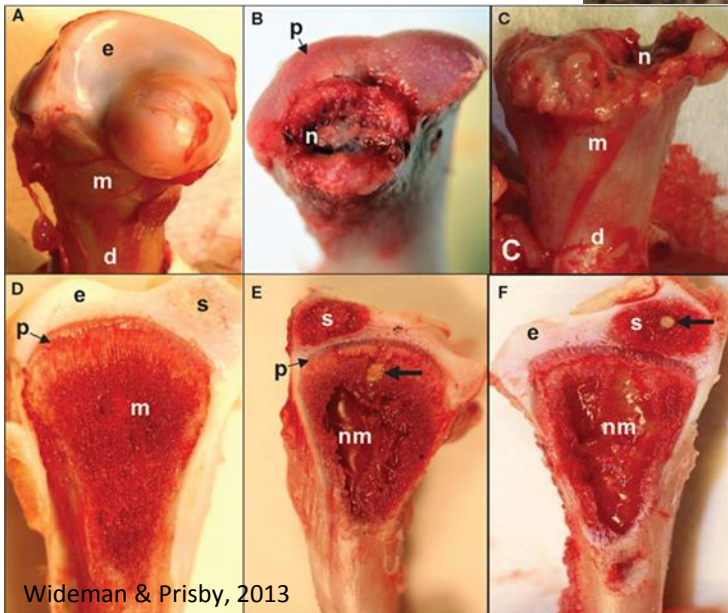
How NE Affects Growth Curve



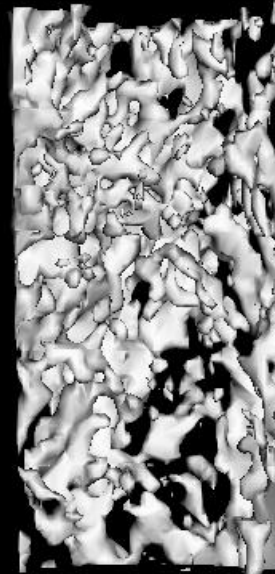
Opportunistic Diseases: Bone Health



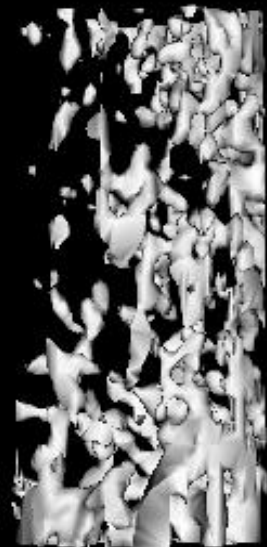
Opportunistic lameness



Wideman & Prisby, 2013

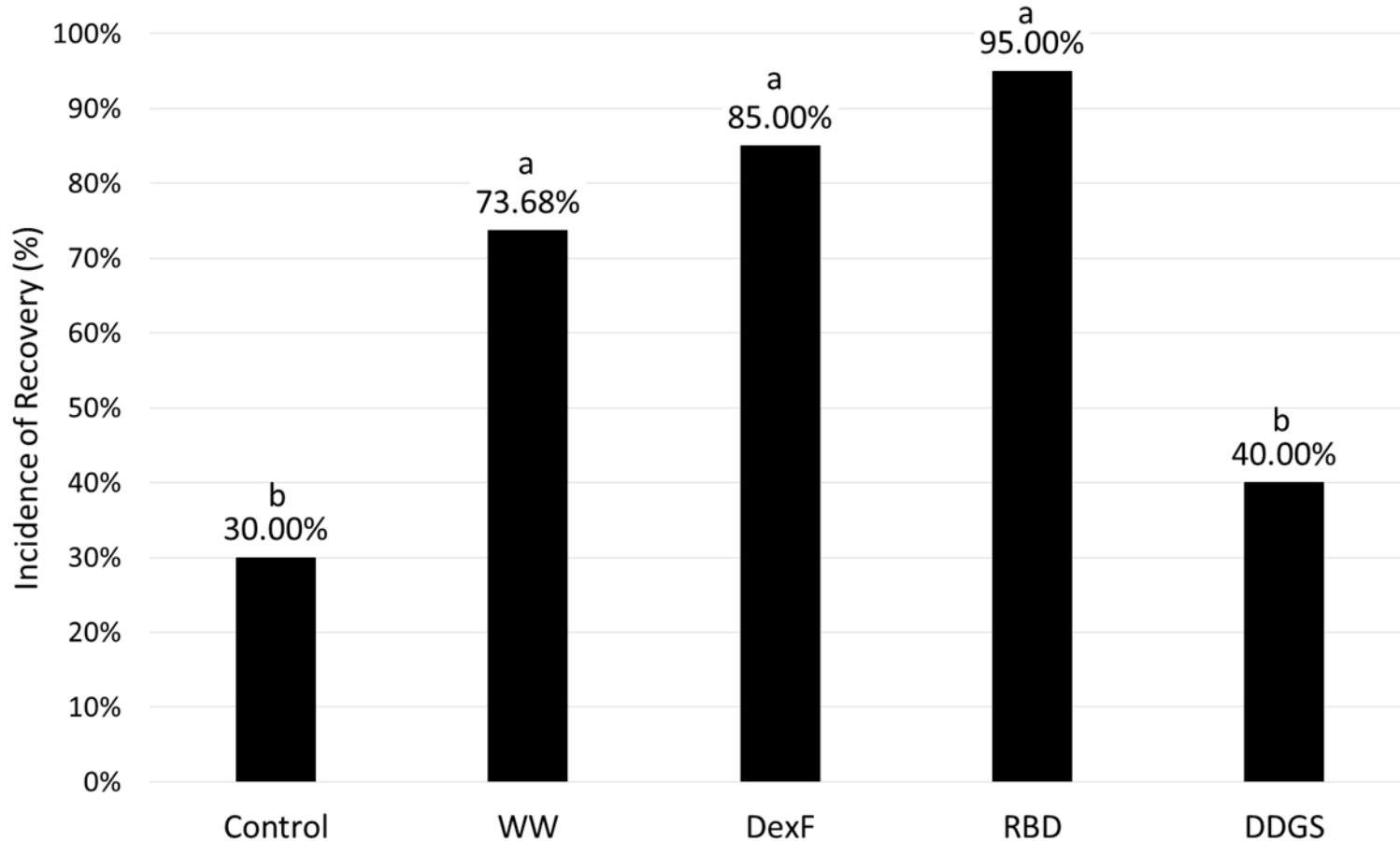


Control



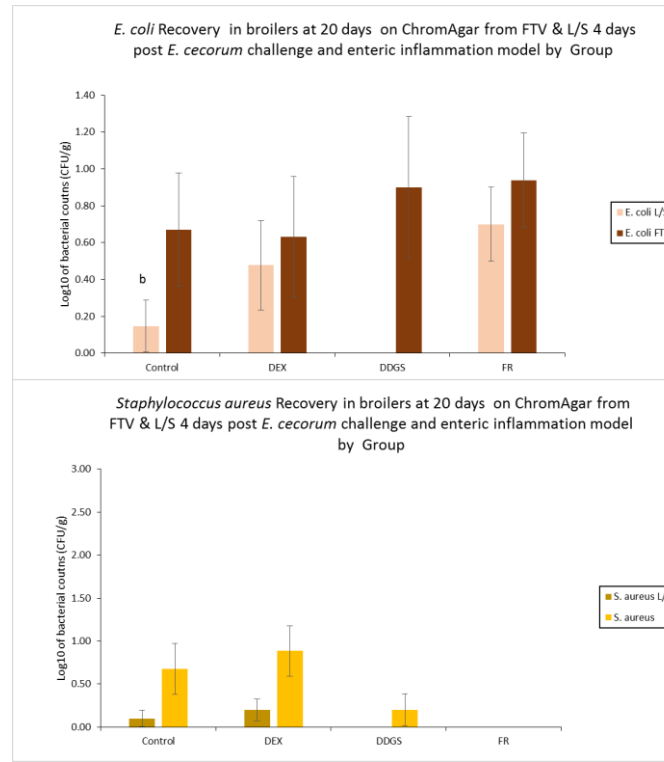
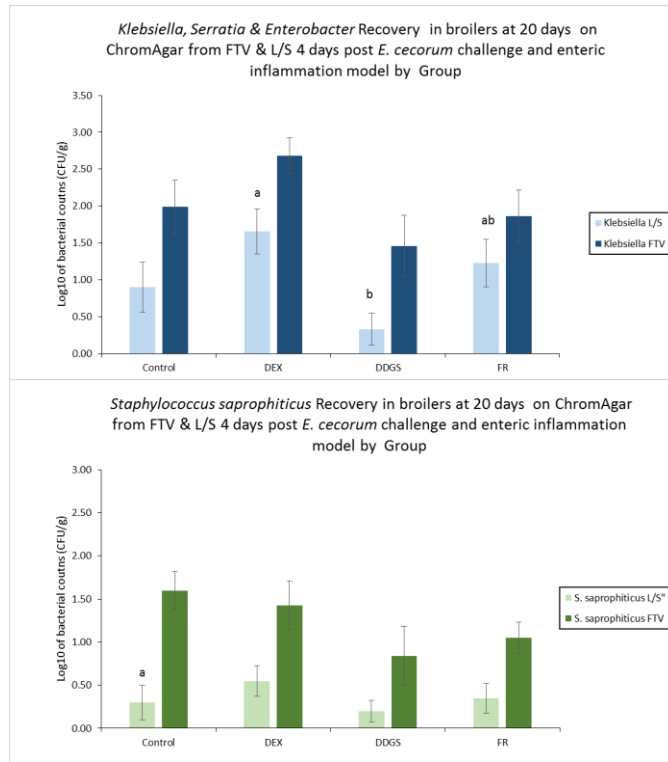
Salmonella

Incidence of *E. cecorum* in FTV Region at 15 Days of Age After Enteric Inflammation Treatment (Exp. 1)

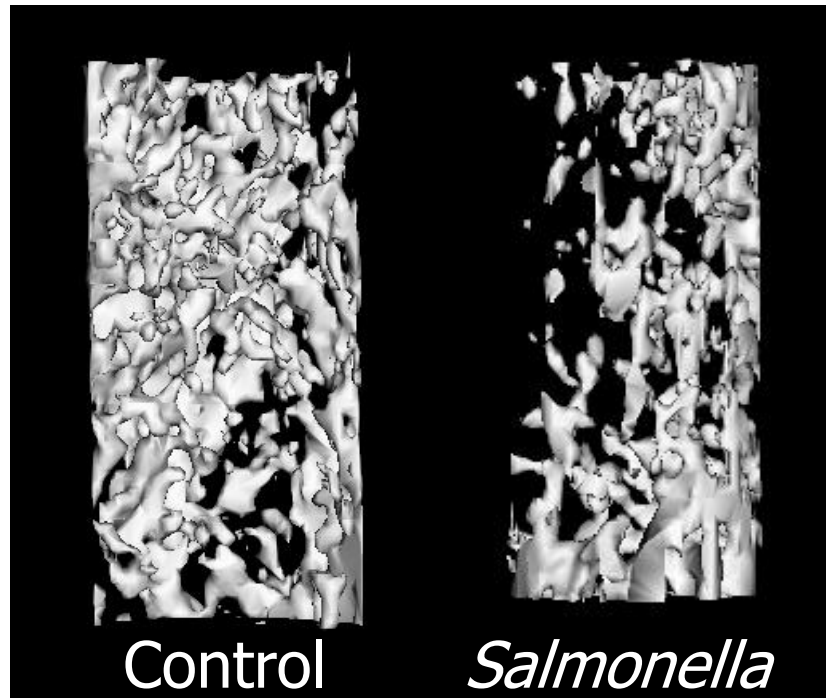


Recent Study – FTV Recovery

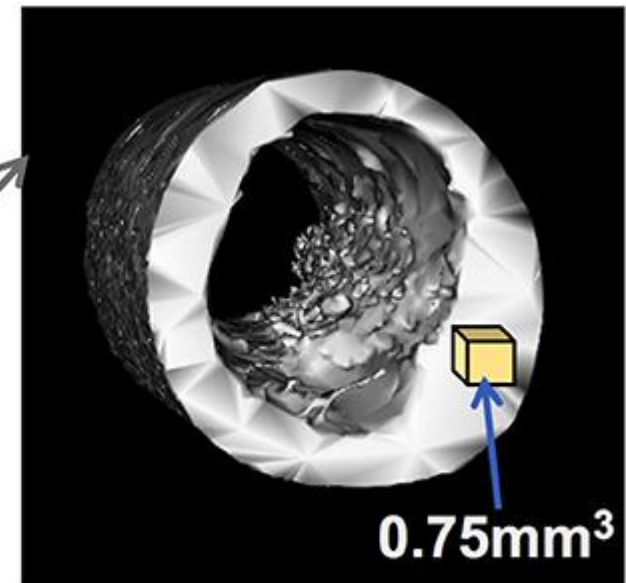
Leaky gut treatments: Control, DEX, DDGS, FR
Collected liver & FTV for microbial recovery



<i>Enterococcus</i> spp.
<i>E. durans</i>
<i>E. faecium</i>
<i>E. hirae</i>
<i>E. gallinarum</i>
<i>E. cecorum</i>
<i>Streptococcus</i> spp.
<i>S. alactolyticus</i>
<i>S. warneri</i>
<i>Staphylococcus</i> spp.
<i>S. haemolyticus</i>
<i>S. cohnii</i>
<i>S. saprophyticus</i>
<i>S. lentus</i>
<i>S. xylosus</i>
<i>S. simulans</i>
<i>Lactobacillus</i> spp.
<i>L. salivarius</i>
<i>L. johnsonii</i>
<i>Escherichia coli</i>
<i>Aerococcus viridans</i>
<i>Alcaligenes faecalis</i>
<i>Acinobacter radioresistens</i>



7 mm³
box



<i>Cortical</i>	Control		Salmonella		
	-	+ MDY	-	MDY (1-21d)	MDY (14-21d)
<i>Large cortical volume (7mm)</i>					
BMD (mg/cm ³)	576 ± 10	557 ± 14	552 ± 14	589 ± 11 *	646 ± 5.2 ^
BMC (µg)	39.4 ± 1.9	36.6 ± 1.2	37.7 ± 1.8	38.1 ± 1.5	44.5 ± 2.0 ^
<i>Small cortical box</i>					
BMD (mg/cm ³)	707 ± 19	698 ± 16	692 ± 21	723 ± 15	756 ± 13 *
BMC (µg)	14.9 ± 0.7	14.7 ± 0.4	14.9 ± 0.8	15.1 ± 0.4	15.6 ± 0.4

In nature...

- Transmission from hen to chick
- Hatched chicks ingest normal microflora in nest or soon after hatch
- Transmission through vaginal inoculation during oviposition or coprophagy has been hypothesized



Reality...



- Eggs are promptly removed from hens and taken to hatchery
- There is no contact between hen and chicks
- Chicks may not receive normal (or minimal) beneficial microbes from hens

Early establishment of intestinal microbiota promotes:

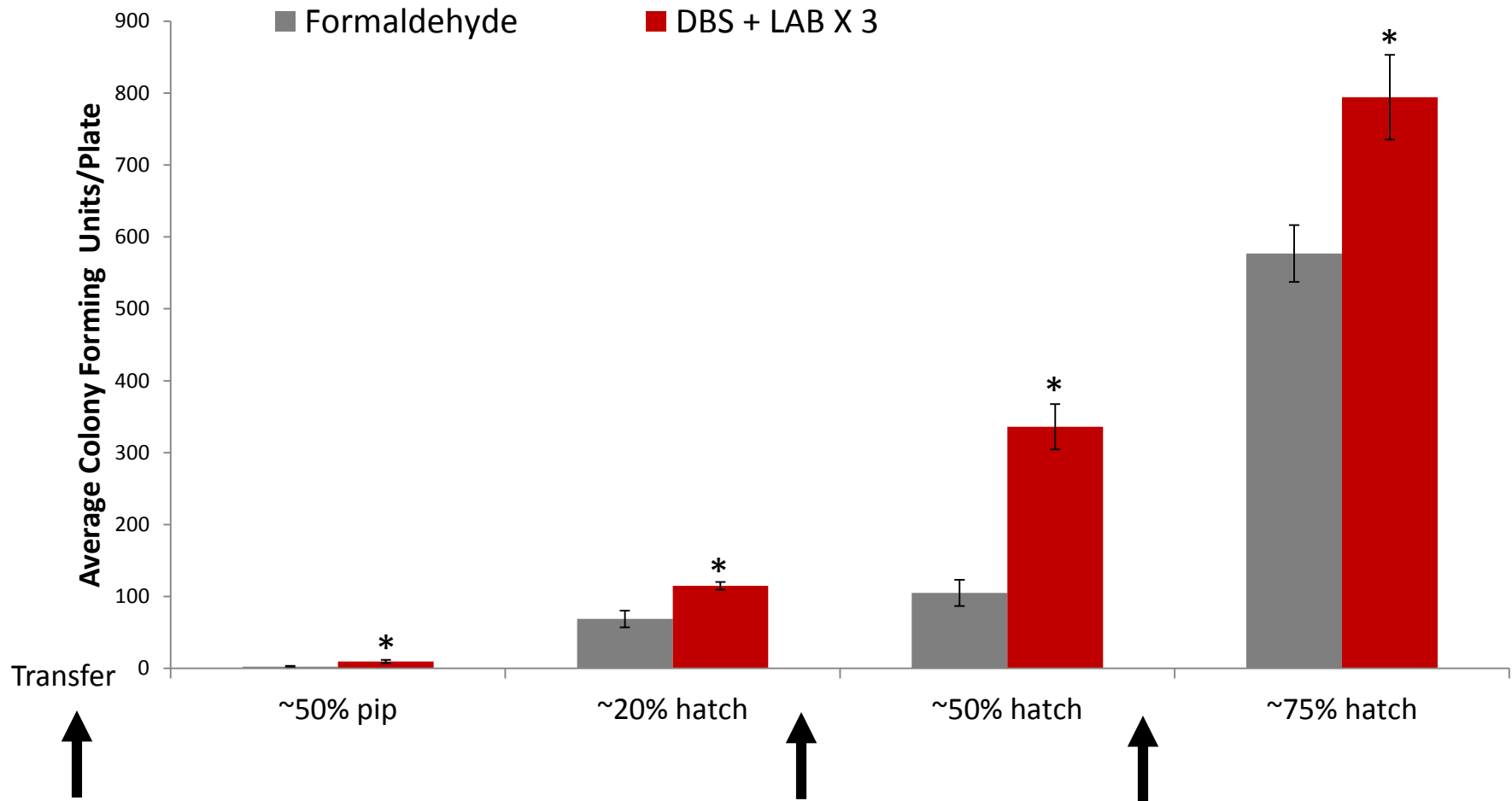
- Proliferation and differentiation of its epithelial lineages
- Regulates angiogenesis
- Modifies the activity of the enteric nervous system
- Extraction and processing nutrients in the diet
- Assembly of the gut-associated lymphoid tissue
- Education of the immune system
- Affects the integrity of the intestinal mucosal barrier

Pioneer Colonizers – Hatchery Inoculation



Courtesy of Dr. John Barta

Lactic Acid Bacteria Recovery From Hatching Cabinets Untreated or Following 3x Applications of Dry Spores and Aqueous LAB

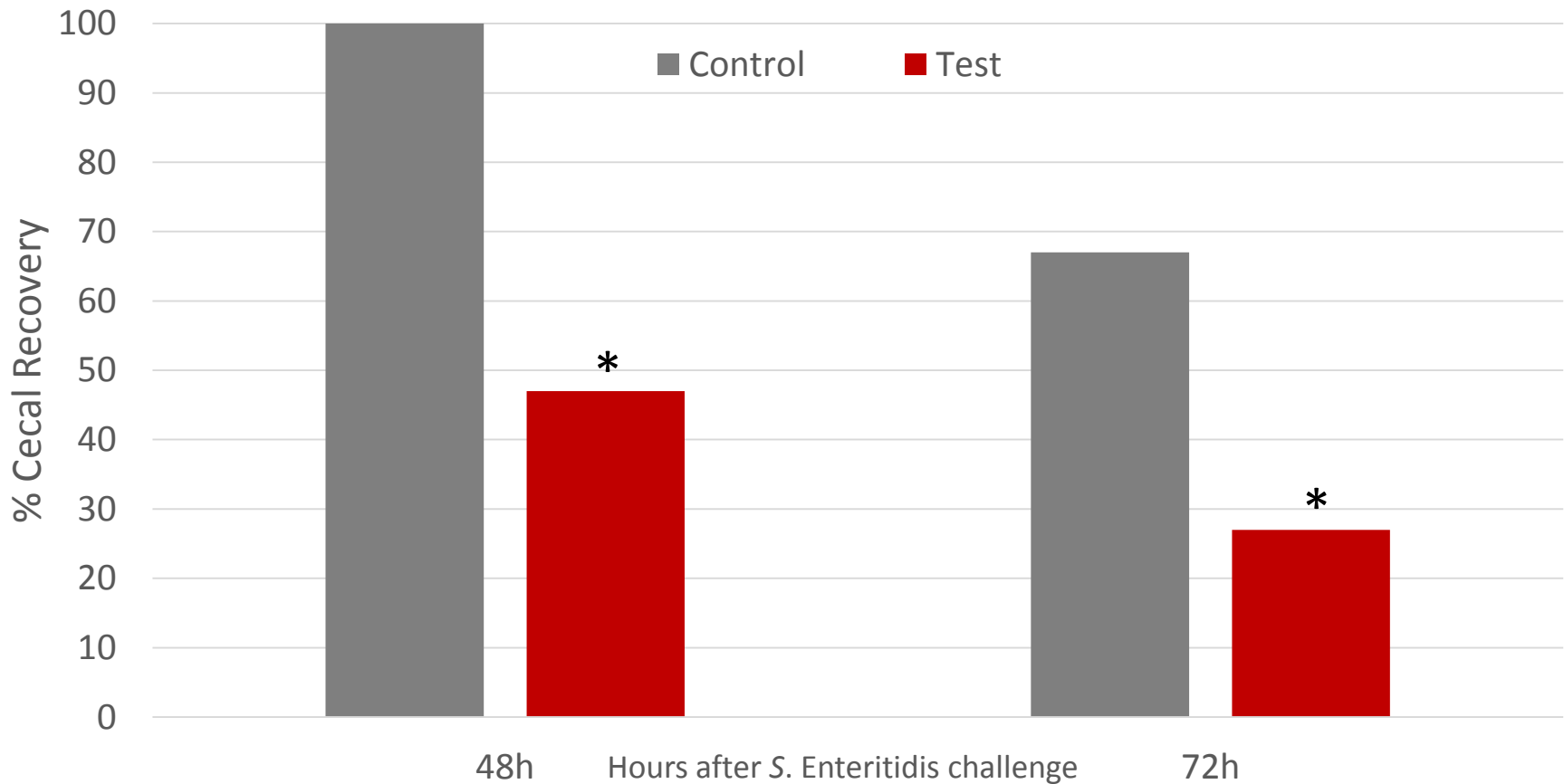


Vertical arrows indicate application times.

* indicate significant ($p < 0.05$) differences within hatch times

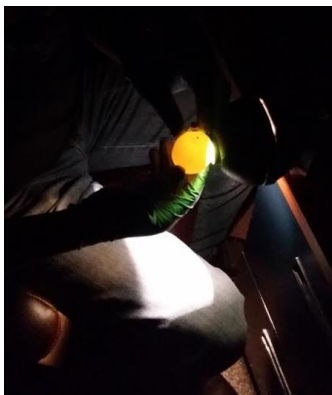
Salmonella Challenge

Cecal recovery of *S. Enteritidis* after treatment in hatch cabinets and challenge on day of hatch

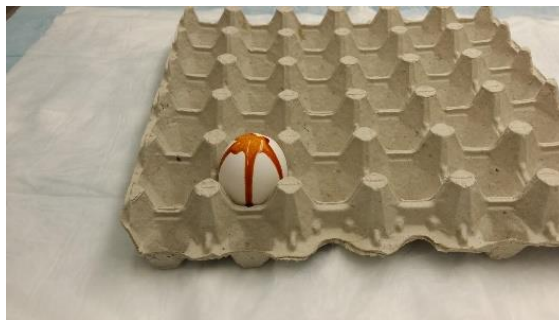


* indicate significant ($p < 0.05$) differences within sampling times

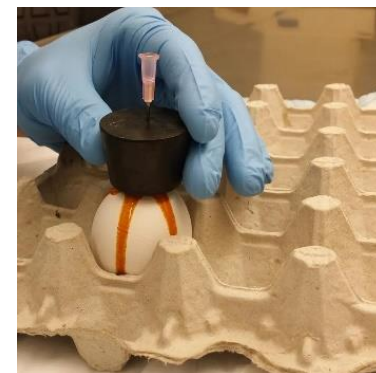
In Ovo Procedure (Sharma and Burmester, 1982)



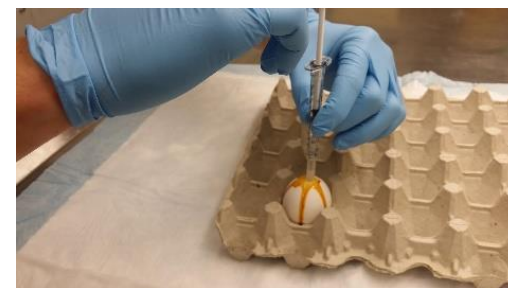
1. Candle



2. Clean



3. Pilot hole



4. Injection

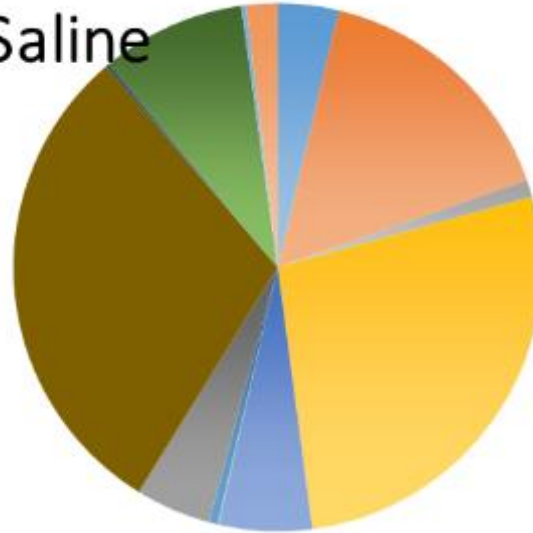


5. Hatch

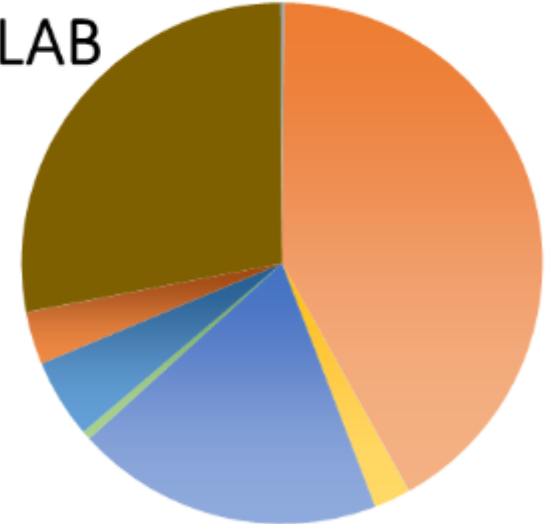
DOH Family Level Microbiome

- Enterococcaceae
- Lactobacillaceae
- Streptococcaceae
- Clostridiaceae
- Lachnospiraceae
- Peptostreptococcaceae
- Ruminococcaceae
- Erysipelotrichaceae
- Shewanellaceae
- Enterobacteriaceae
- Neisseriaceae
- Halomonadaceae
- Pseudomonadaceae
- Other, unclassified

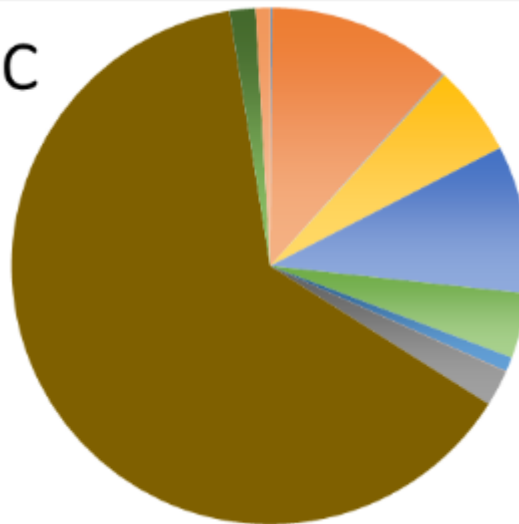
Saline



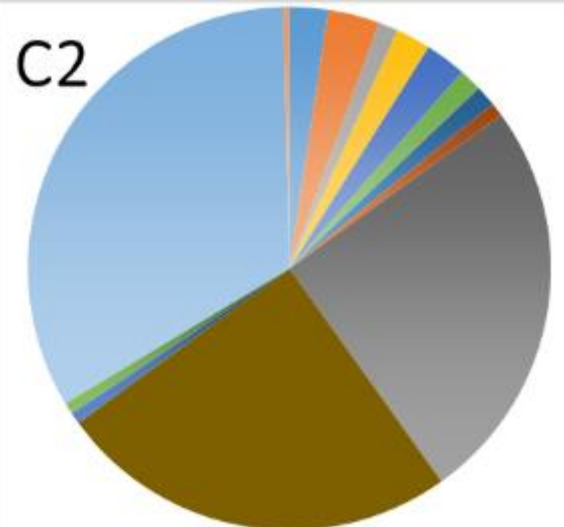
LAB



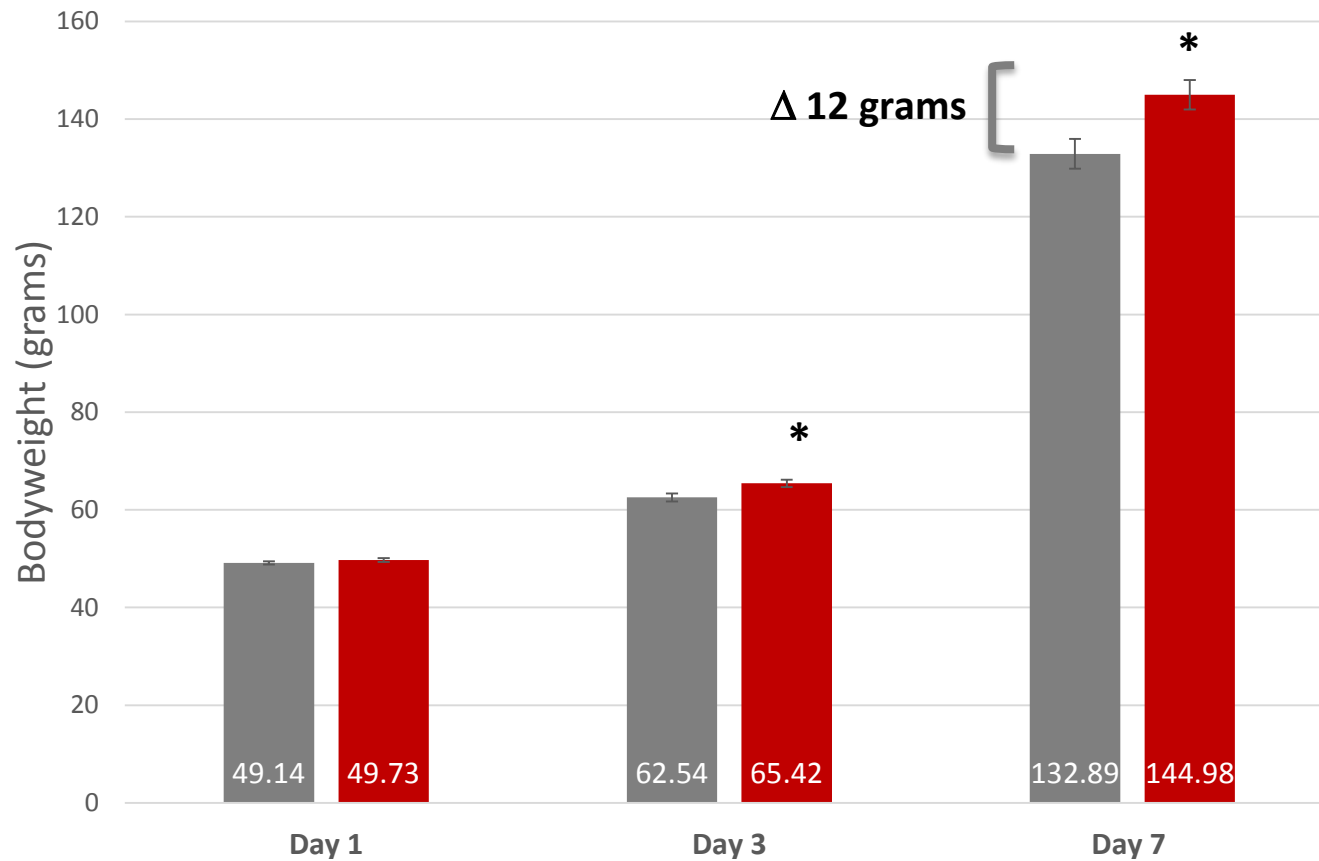
C



C2



Average body weight of all birds per treatment at days 1, 3, and 7 after *in ovo* inoculation, **Exp 1**



* Indicates significantly ($p < 0.05$) different means

Activation State

Categories	Functions Annotation	C	C2	L
Free Radical Scavenging	Synthesis of reactive oxygen species	--	-1.330	-1.886
	Production of reactive oxygen species	--	--	-1.461
Inflammatory Response, Organismal Injury and Abnormalities	Inflammation of organ	2.219	--	0.856
	Inflammation of absolute anatomical region	--	--	0.591
	Immune response of phagocytes	--	0.931	--
	Immune response to leukocytes	--	-0.014	--
	Response of antigen presenting cells	--	0.787	--
	Response of myeloid cells	--	1.236	--
Cell-To-Cell Signaling	Aggregation of cells	1.744	1.264	-0.886
	Cell-cell contact	2.599	--	0.200

Is there a single answer?

- Multiple pieces to the puzzle
- Probiotics can be used to control diseases and boost performance, possibly by controlling inflammation and immune response.
- The old idea of competitive exclusion still stands, but is likely more complex than originally thought.
- 100,000X more bacteria in one GIT than people on the planet, and look how complicated our world is, the GIT must be even more so.

THANK YOU

Collaborators:

Dr. Anita Menconi

Dr. Vivek Kuttapan

Dr. Juan-David Latorre

Dr. Guillermo Tellez

Dr. Billy Hargis

Dr. Xochitl Hernandez

Dr. Billy Hargis

Dr. John Barta

Dr. Kim Wilson

Whitney Briggs

Audrey Duff

Kaylin Krueger

Danielle Mahaffey

Lucas Graham

Kyle Teague

Dr. Mikayla Baxter

Eduardo Vicuña

Amanda Wolfenden

