Phytogenics and resilience to intestinal infections

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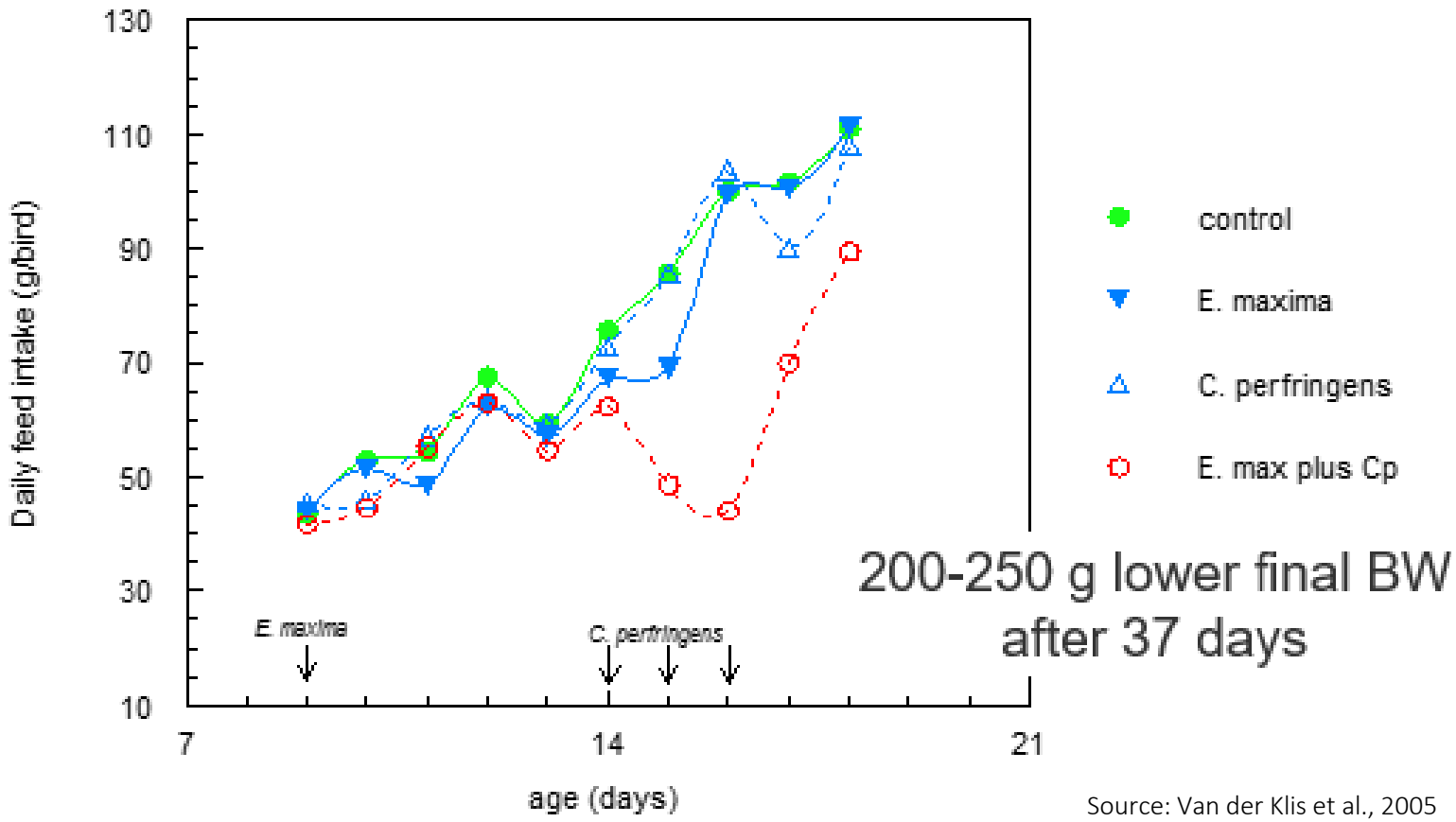
FIAAP ANIMAL NUTRITION CONFERENCE 2018

Presented by: FeedStrategy WATT GLOBAL MEDIA VICTAM Asia 2018 FIAAP grapas

Contents

- What is happening during intestinal infections?
- Gastrointestinal tract as first line of defense
- How do phytogenics support these functions

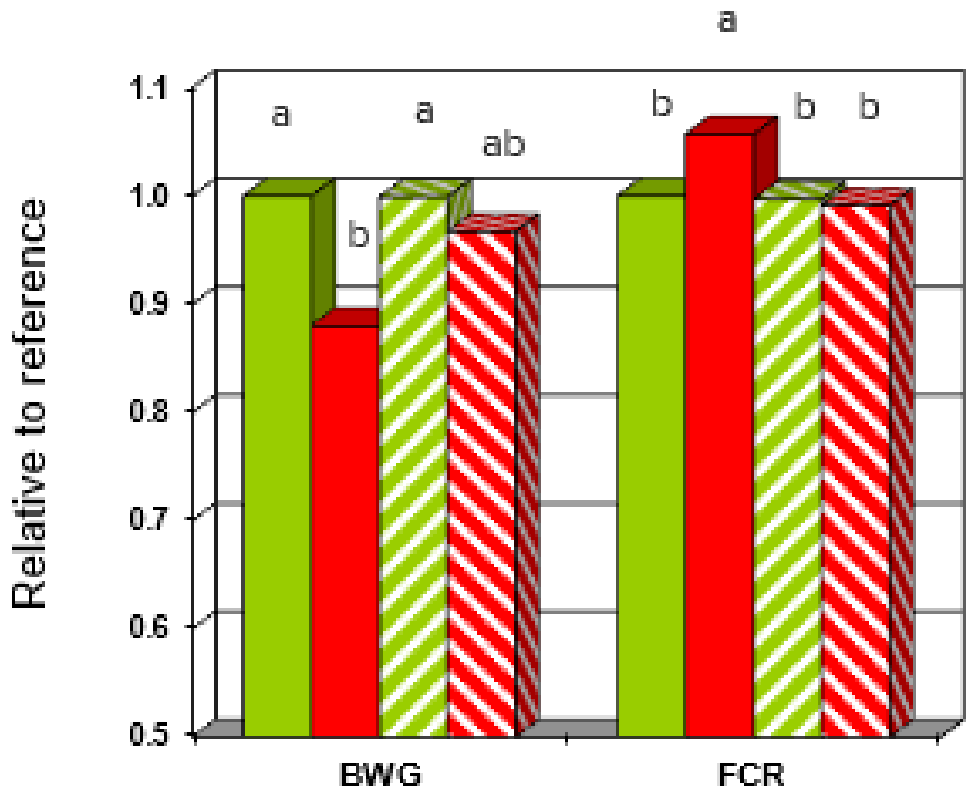
Effects of coccidiosis due to secondary bacterial infections



200-250 g lower final BW after 37 days

Source: Van der Klis et al., 2005

Anti-inflammatory effects



NE lesions (%)

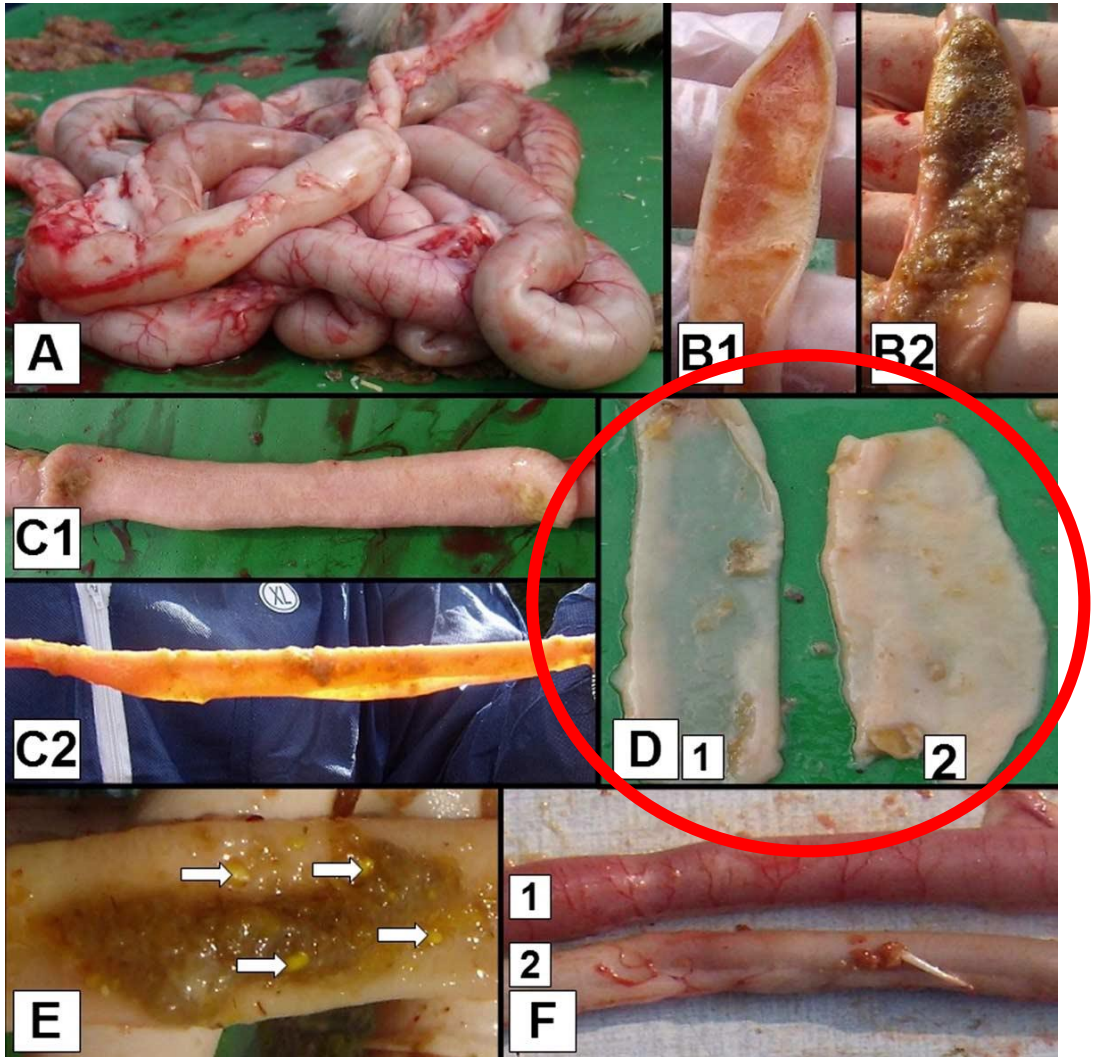
1 dpi	2 dpi
0	0
68	61
0	0
52	60

NE: Necrotic enteritidis: D9 E.maxima; D14,15 Cpf

NINT is reference (100%)

Source: Van der Klis, 2012

Dysbacteriosis/ subclinical enteritis



- Gut ballooning
- Orange mucoid and foamy contents
- 1. Good tonus;
  2. Lack of tonus
- 1. Thin GI wall
  2. Normal GI wall
- Undigested feed in colon
- 1. Inflammation
  2. No inflammation

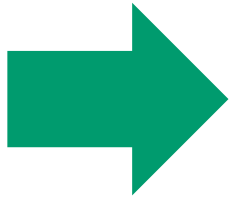
Source: Teirlynck et al (2011)

Integrity and absorption
Gizzard function
(Anti)peristalsis
Retention time

Intestinal challenges:

Major challenges:

- Coccidiosis
- Dysbacteriosis
- Necrotic enteritis



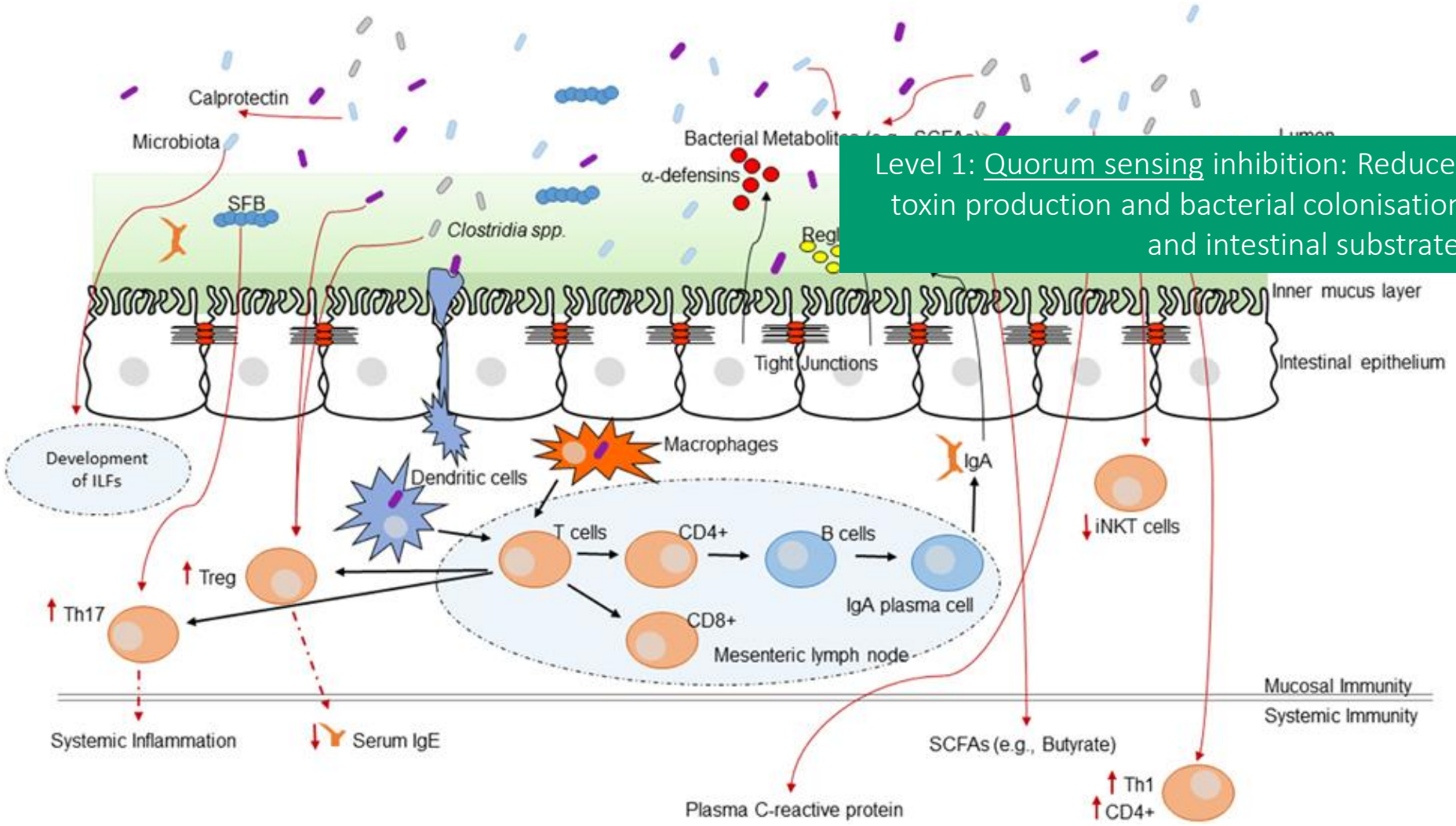
Consequences:

- Reduced weight gain
- Poor uniformity
- Wet litter

- Inflammation:
  - reduced feed intake
  - body tissue degradation
- Impaired intestinal integrity
- Bacterial translocation
- Reduced nutrient digestibility
- Reduced food safety

NE: A typical
250 g BW loss at d35

First line of defence?



Level 1: Quorum sensing inhibition: Reduced toxin production and bacterial colonisation, and intestinal substrates

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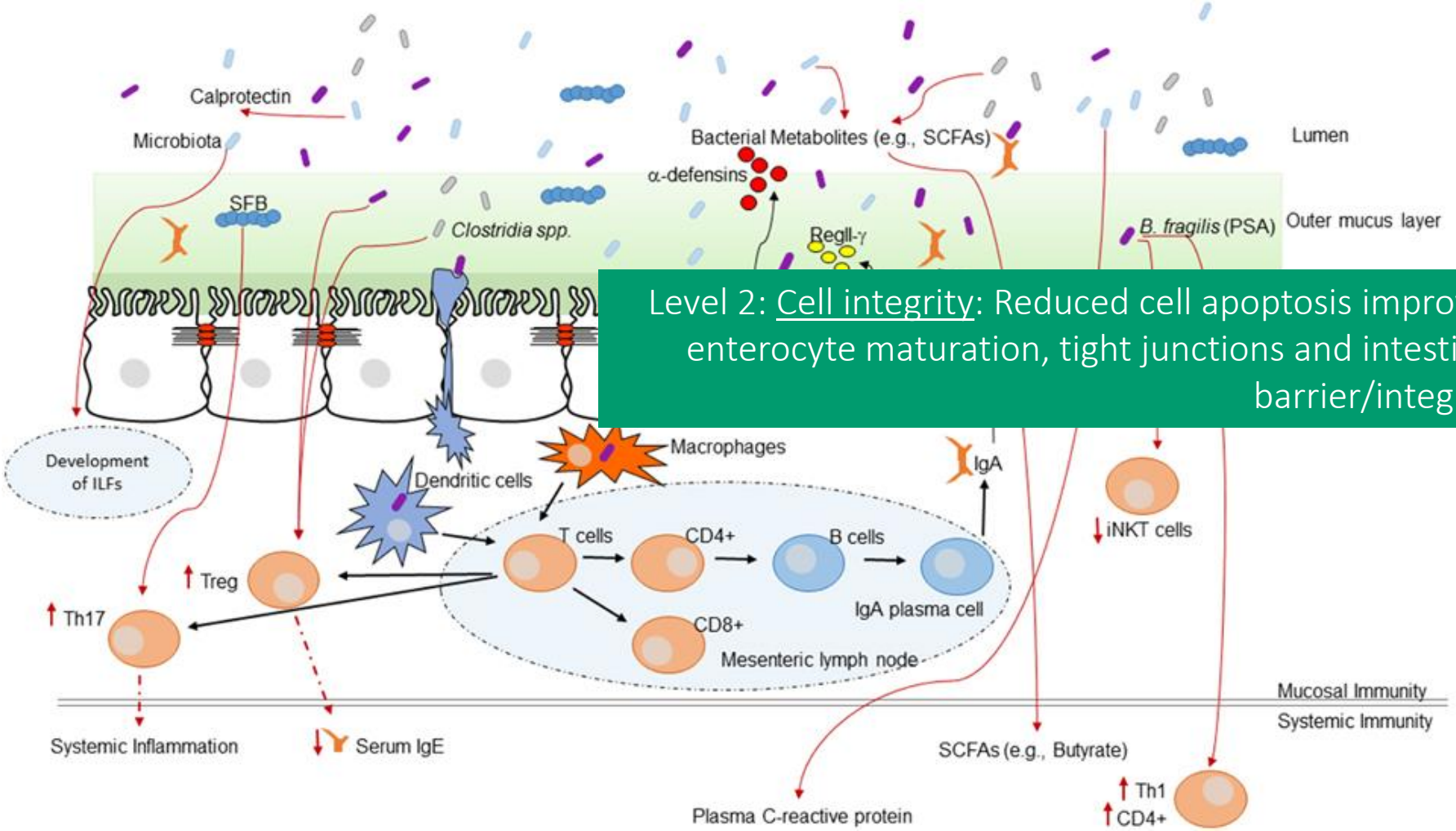
First line of defence?



Level 2: Cell integrity: Reduced cell apoptosis improves enterocyte maturation, tight junctions and intestinal barrier/integrity

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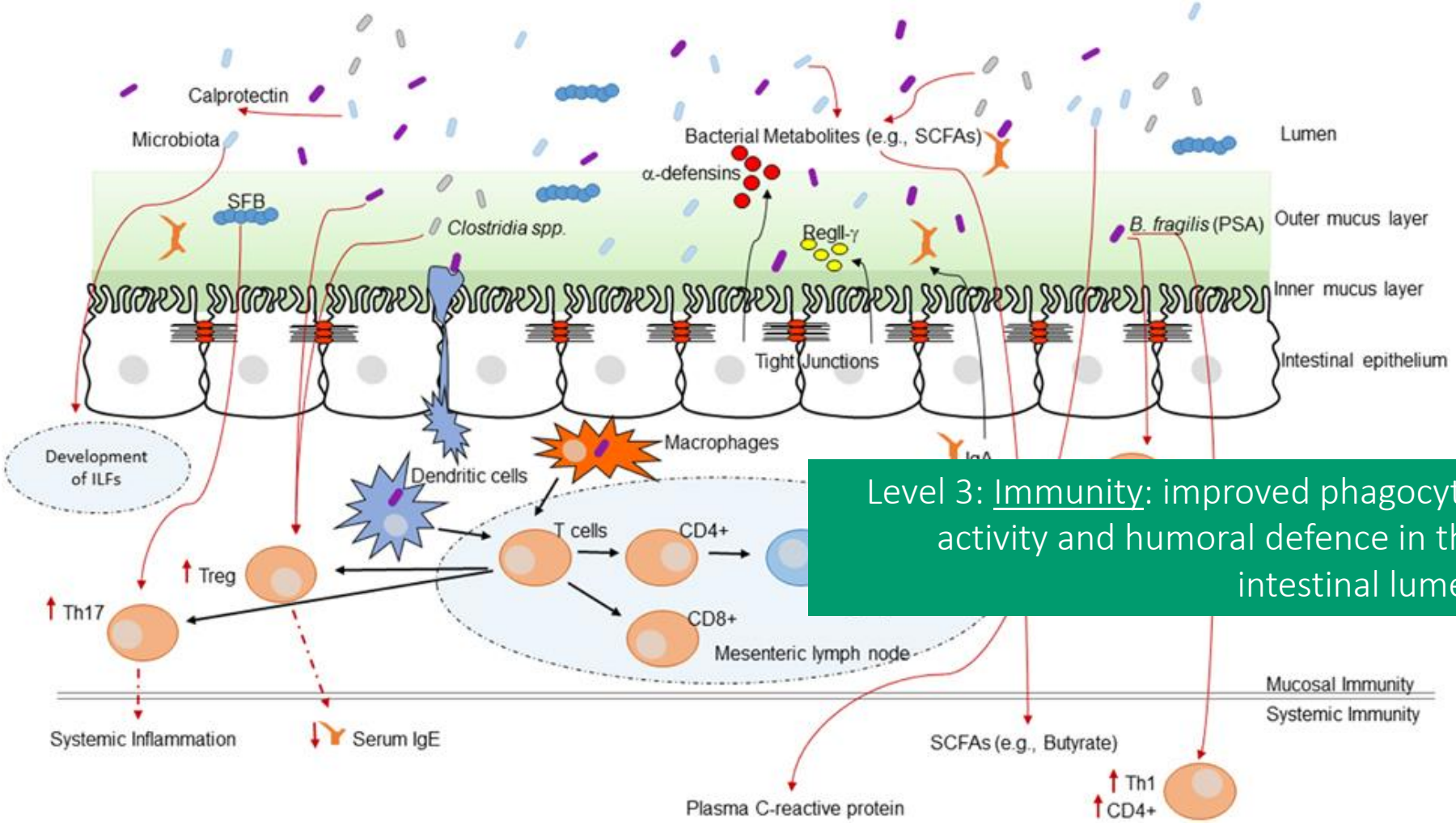
First line of defence?



Level 3: Immunity: improved phagocytic activity and humoral defence in the intestinal lumen

In summary:

Reduced pathogen load:

Nutritional measures:

- Protein digestibility
- Amino acid profile
- Energy source
- Insoluble fibre
- Feed particle size

Pathogenicity:

- Antibacterial effects
- Quorum sensing inhibition

Improved intestinal defence:

- Physical barrier – intestinal integrity
- Reduce intestinal oxidation and inflammation
- Improve humoral and cellular immunity

Phytogenics: What are those?

produced by plants

Definition:

'Plant-derived, natural bio-active compounds'

(e.g. Puvaca et al. (2013)

Secondary metabolites, comprise

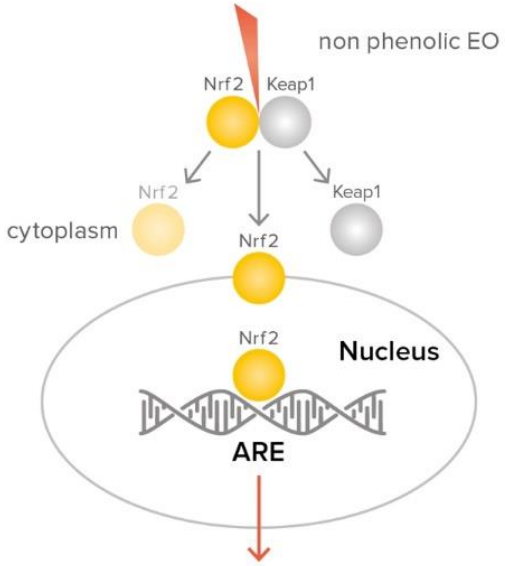
- essential oils,
- herb extracts,
- oleoresins,
- tannins
- flavonoids, and
- saponins

complex chemicals made by plants that are not essential to the life of the **plant**.

Phytogenics and anti-oxidant effects

Indirect

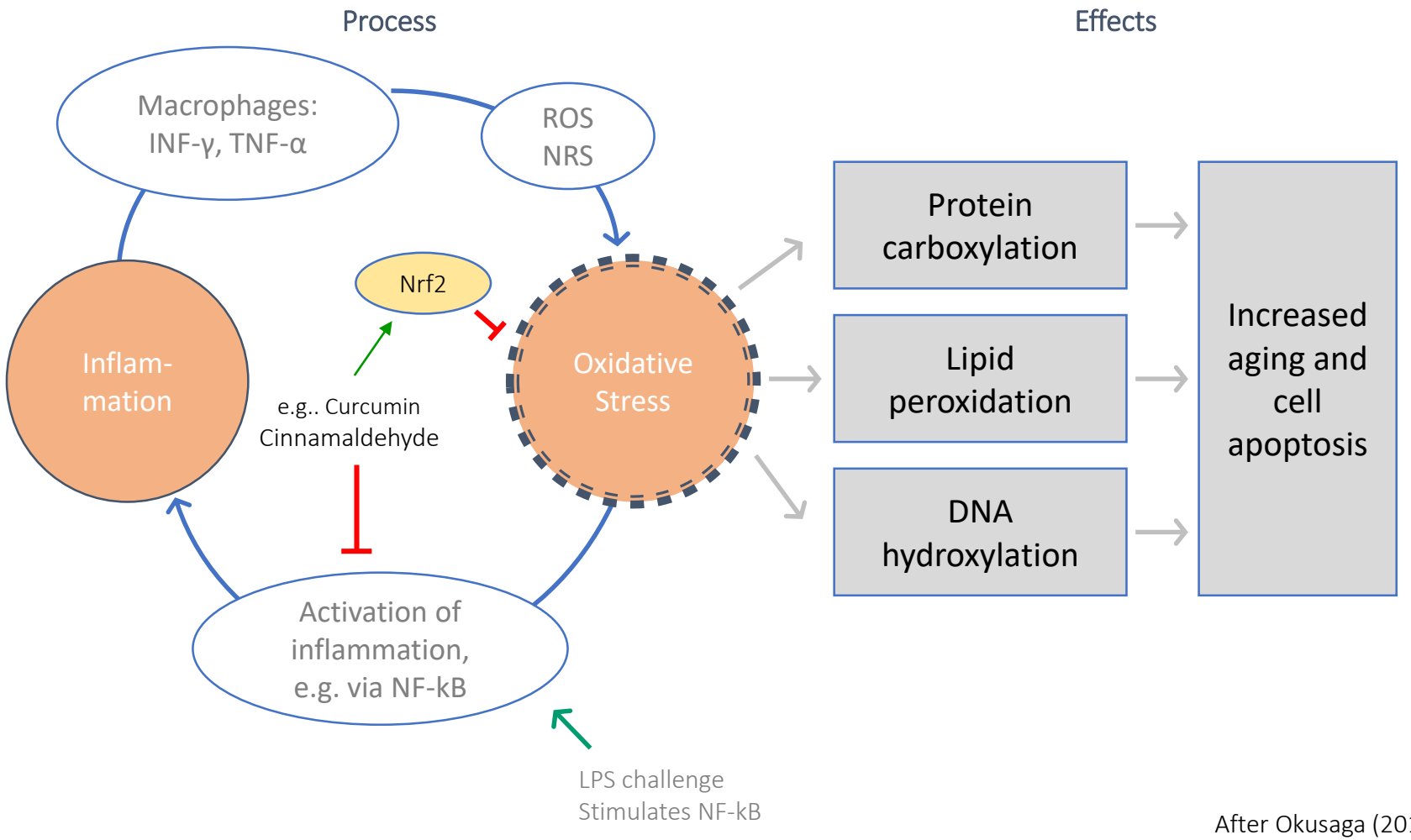
Stimulation of synthesis of anti-oxidant enzymes



Antioxidant enzymes
(SOD, NQO1, GSH-Px, HO)

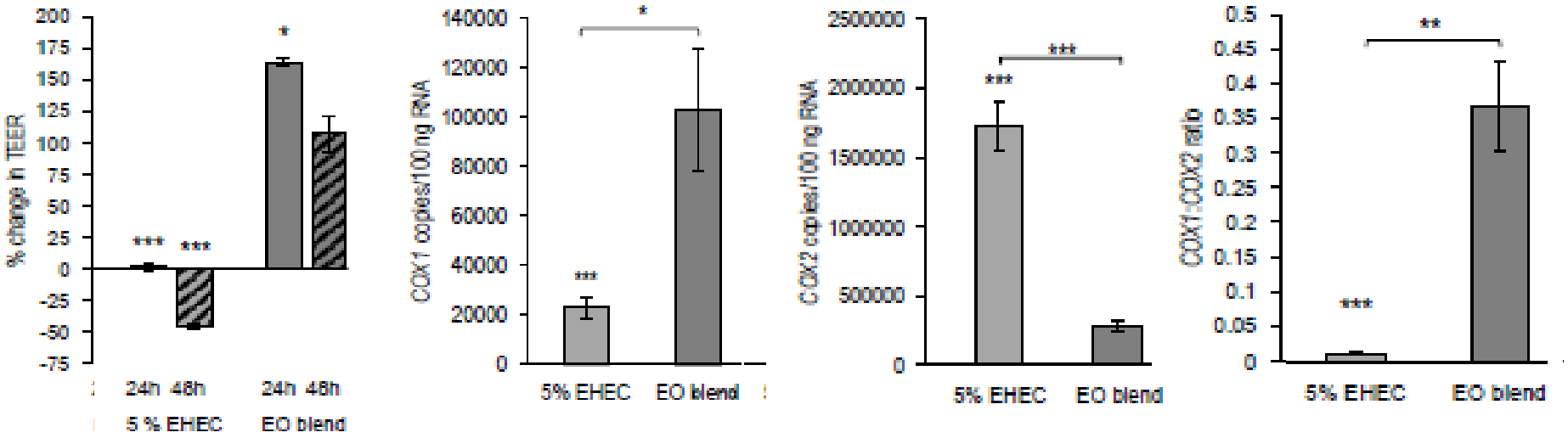
Turmeric, oregano, thyme and rosemary oil increased anti-oxidant enzyme production in jejunal mucosa (Mueller et al., 2012)

Phytogenics break the oxidation/ inflammation cascade



After Okusaga (2014)

Thymol & cinnamaldehyde in Caco-2 cells



Essential oil blend (thymol 15 mg/l; cinnamaldehyde 5 mg/l) prevented adverse effects of E. coli O157:H7 (EHEC) cell free metabolites in Caco-2 cells on tight junction integrity, COX-1 (homeostasis/mucosal protection) and COX-2 (pro-inflammatory response via prostaglandins) induced gene expression.

adapted from Putaala et al. (2017)

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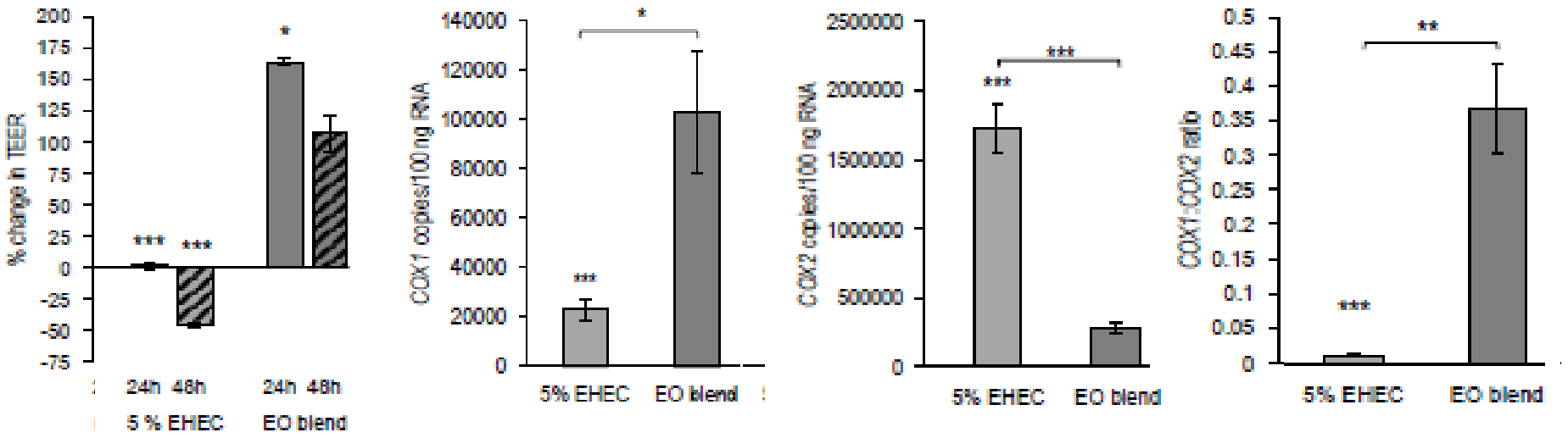

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Take home messages

Phytogenics are a broad class of secondary plant metabolites with diverse physiological functions:

- Reduce pathogenicity of microbiota via quorum sensing inhibition
- Local anti-oxidant and anti-inflammatory effects improve intestinal integrity
- Improve enterocyte maturation
- Increase enzyme production and nutrient transport across the intestine

Effects depend on (combination of) actives and dose level!