Challenge of late immunity in laying hens older than 60 weeks

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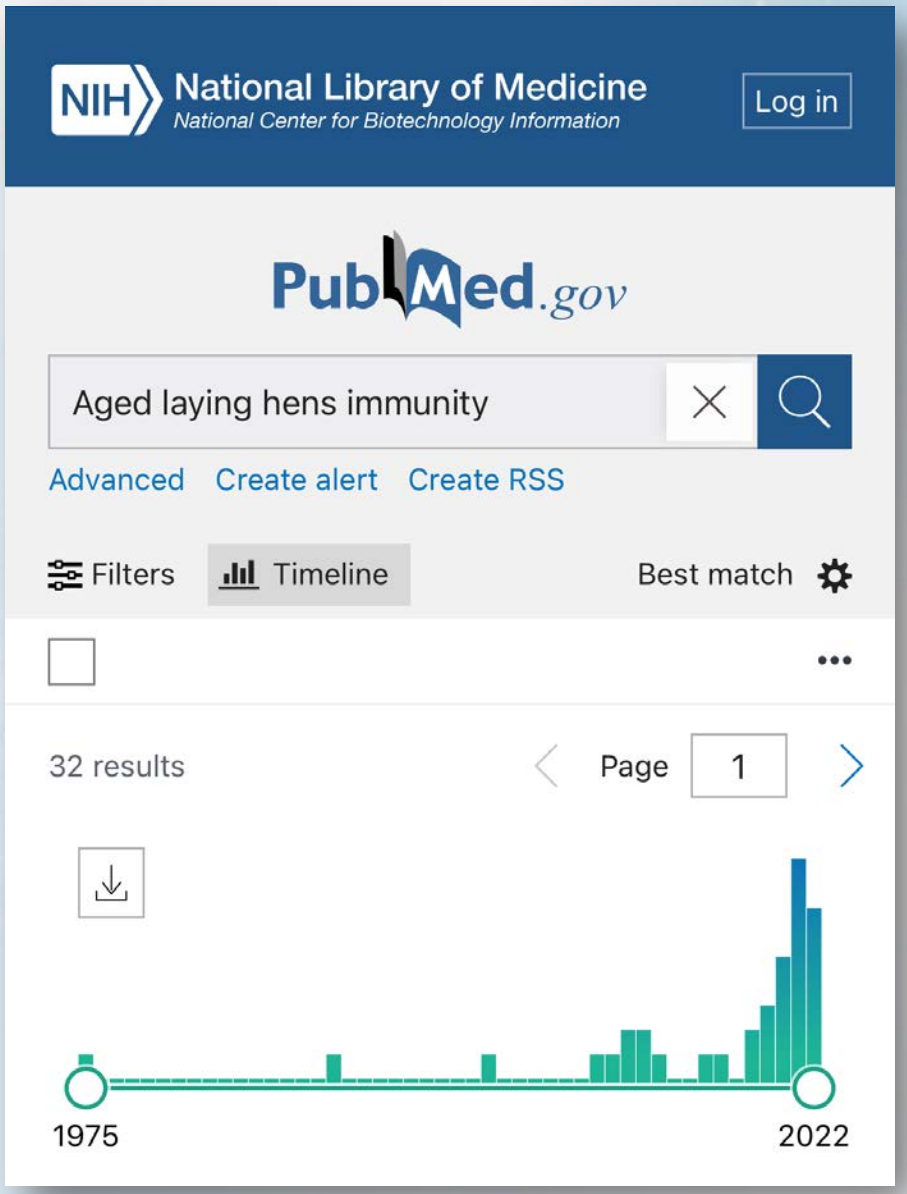
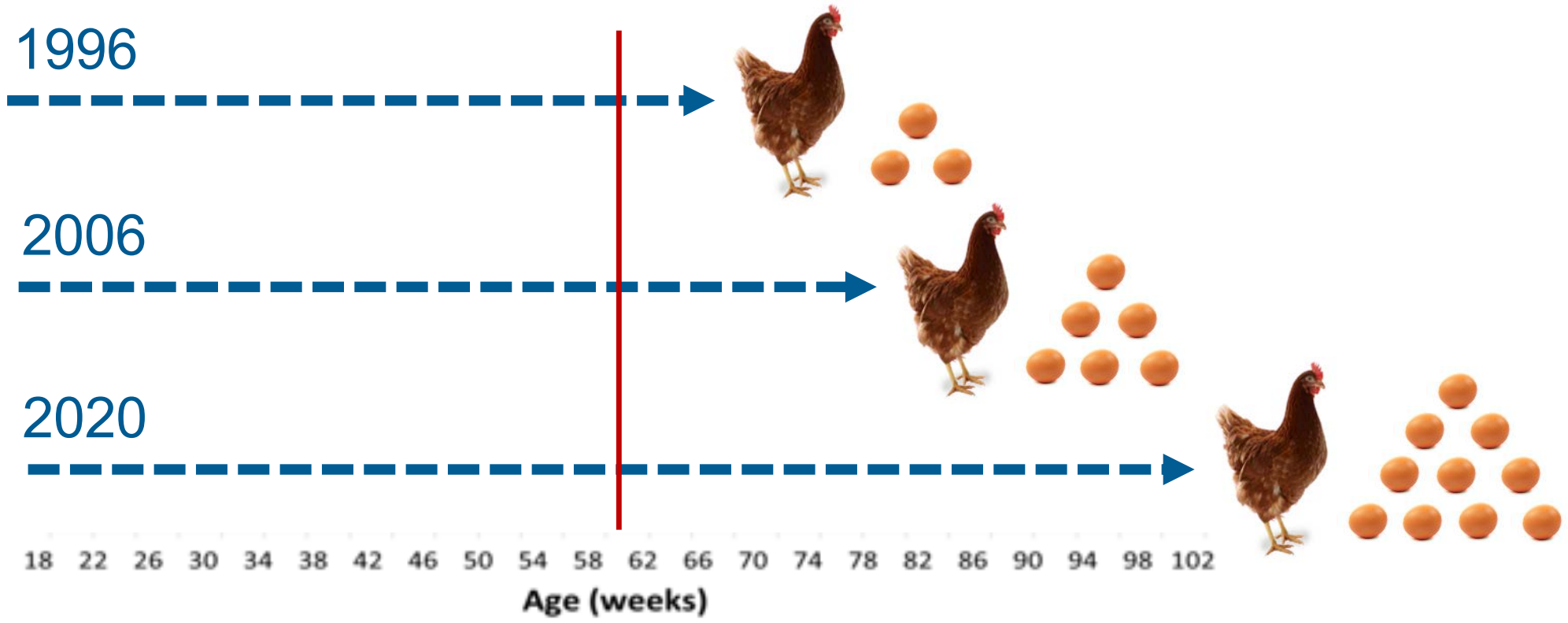


Why is there so much interest about immunity in the aged laying hens now?

Evolution of the life cycle in laying hens

65 weeks are the new 40 weeks for laying hens



Can the immune system of hens endure to such an advanced age?

Immune system

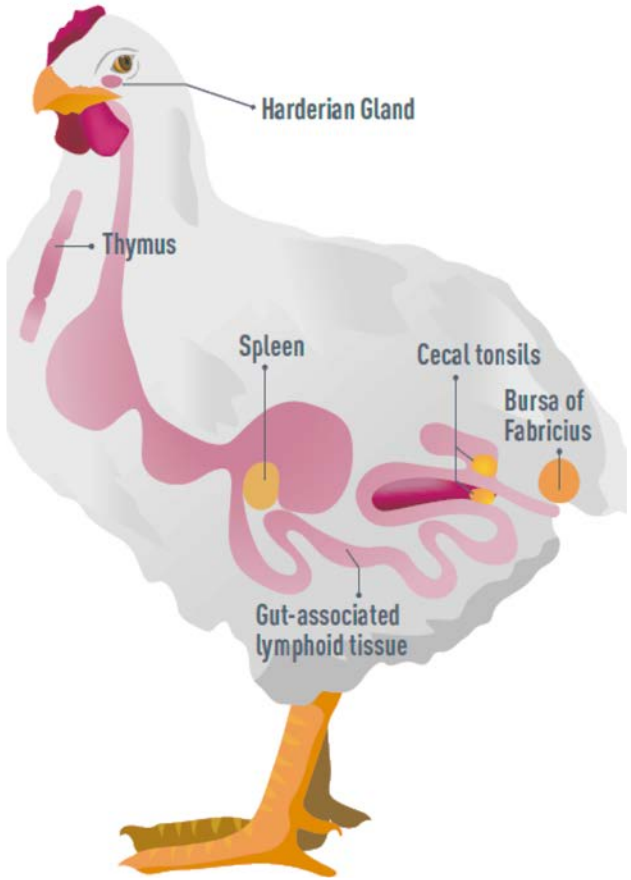
Main lymphoid in poultry

PRIMARY

Bursa of Fabricius
Thymus

SECONDARY

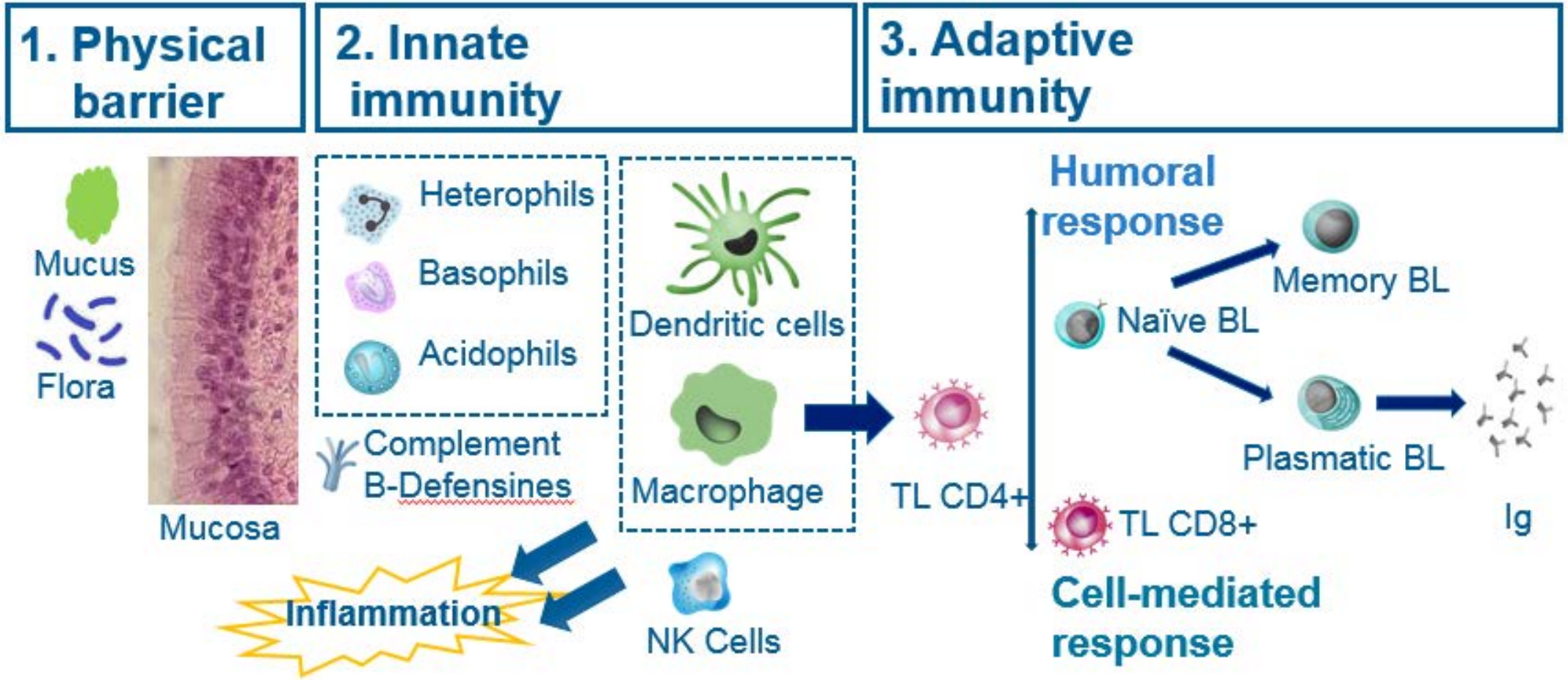
Spleen
Cecal tonsils
Harderian gland
GALT



- Birds are not mammals, Layers are not broilers
- Lack of capsulated lymph nodes
- 70% of white cells attached to the gut

The immune response

First contact



The immune response

Second contact

1. Physical barrier

Mucus

Flora

Ig A

2a. Innate immunity

Heterophils

Basophils

Acidophils

Dendritic cells

Macrophage

Complement

NK Cells

2b. Adaptive immunity

Ig M

TL CD8+

Memory LB

Plasmatic LB

TL CD4+

Humoral response

Cell-mediated response

The immune response

Communication is crucial: immunopeptides

Interleukins

IL-1β, IL-18

IL-2, IL-15 , IL-21

IL-3, IL-4,IL-5, IL-13

IL-12, IL-12α,IL-12β

IL-17A, IL-17B, IL-17D,IL-17F

IL-10,IL-19, IL-22, IL-26

IL-6, IL-7,IL-9, IL-11, IL-16

Chemokines

XC, CC, CXC and CX3C

Interferons

IFN-α, IFN-β, IFN-λ

IFN-γ

Transforming growth factor β

TGF-β2, TGF-β3, TGF-β4

Tumour Necrosis Factor

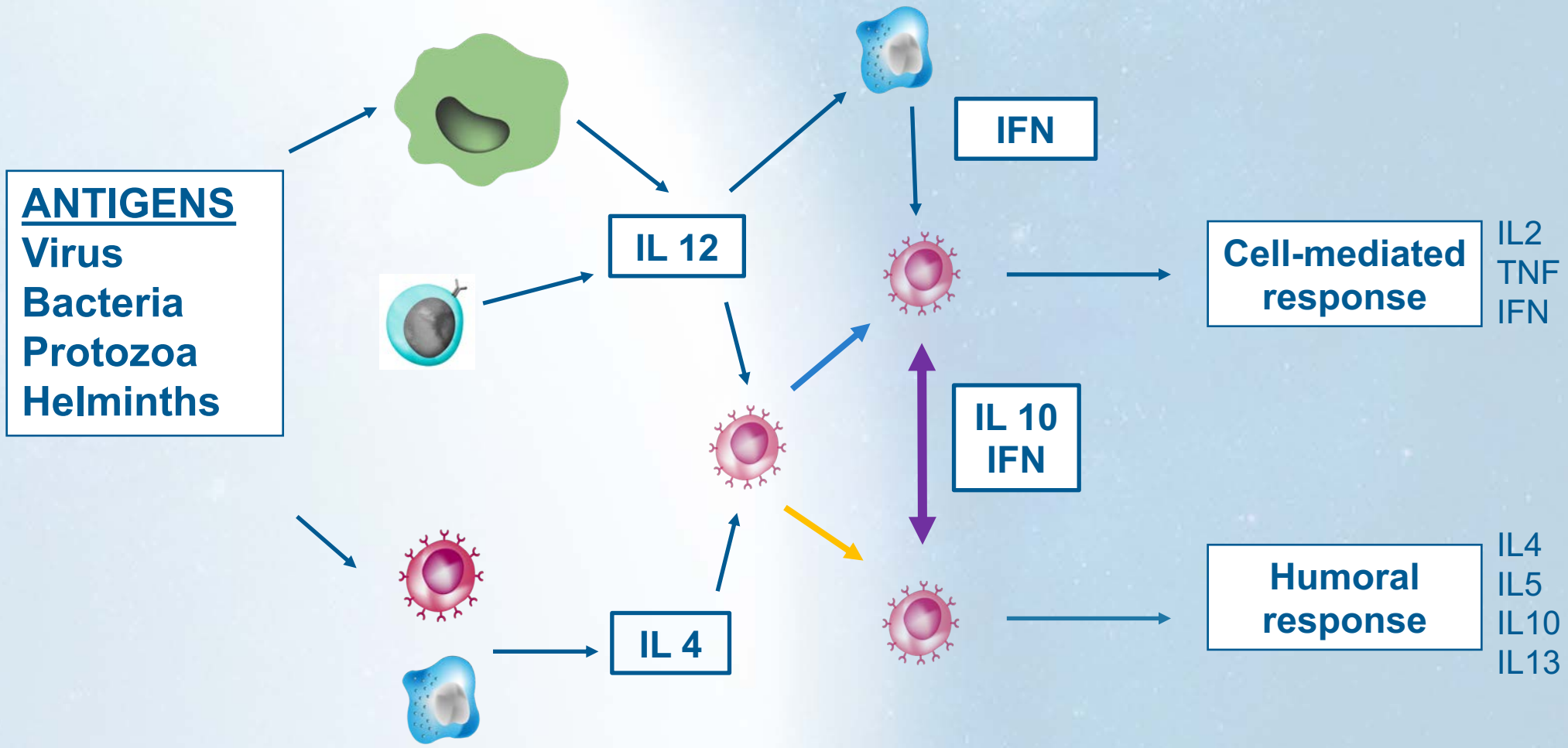
TNFSF2 (TNF-α),TNFSF4, TNFSF18,TNFSF6, TNFSF8, TNFSF15, TNFSF5, TNFSF10, TNFSF11, TNFSF13B

Colony-Stimulating Factors

GM-CSF, MGF

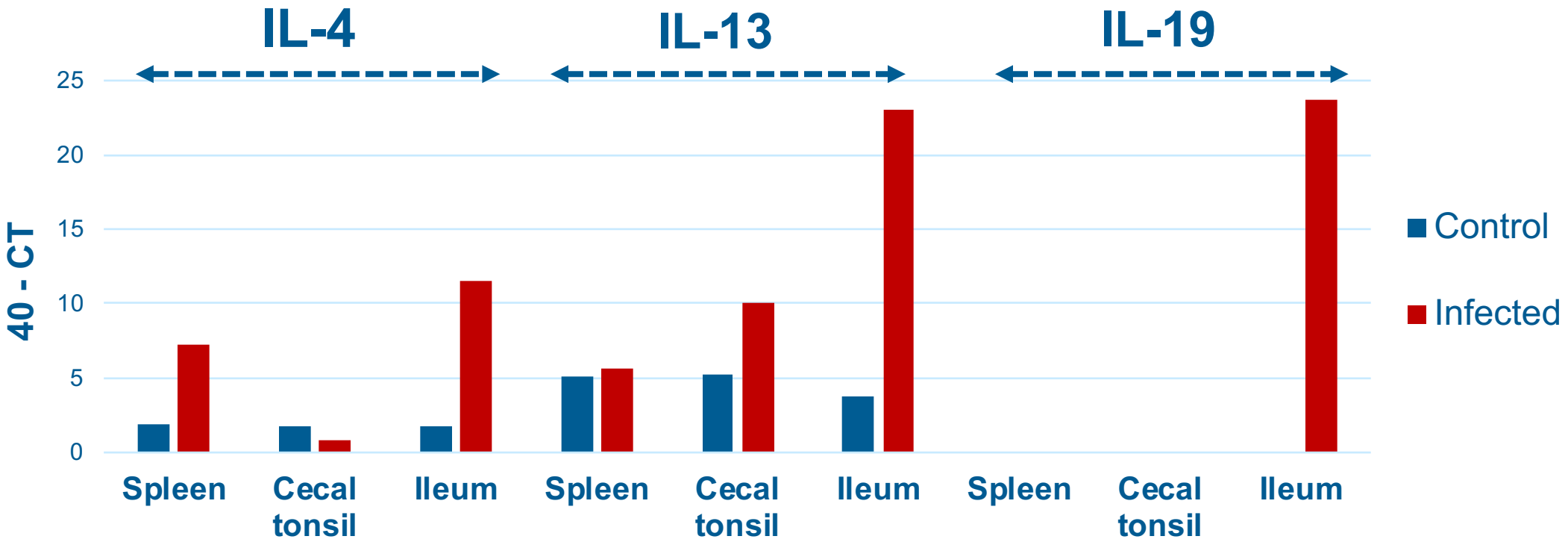
The immune response

Not maximize but optimize for the challenge



The immune response

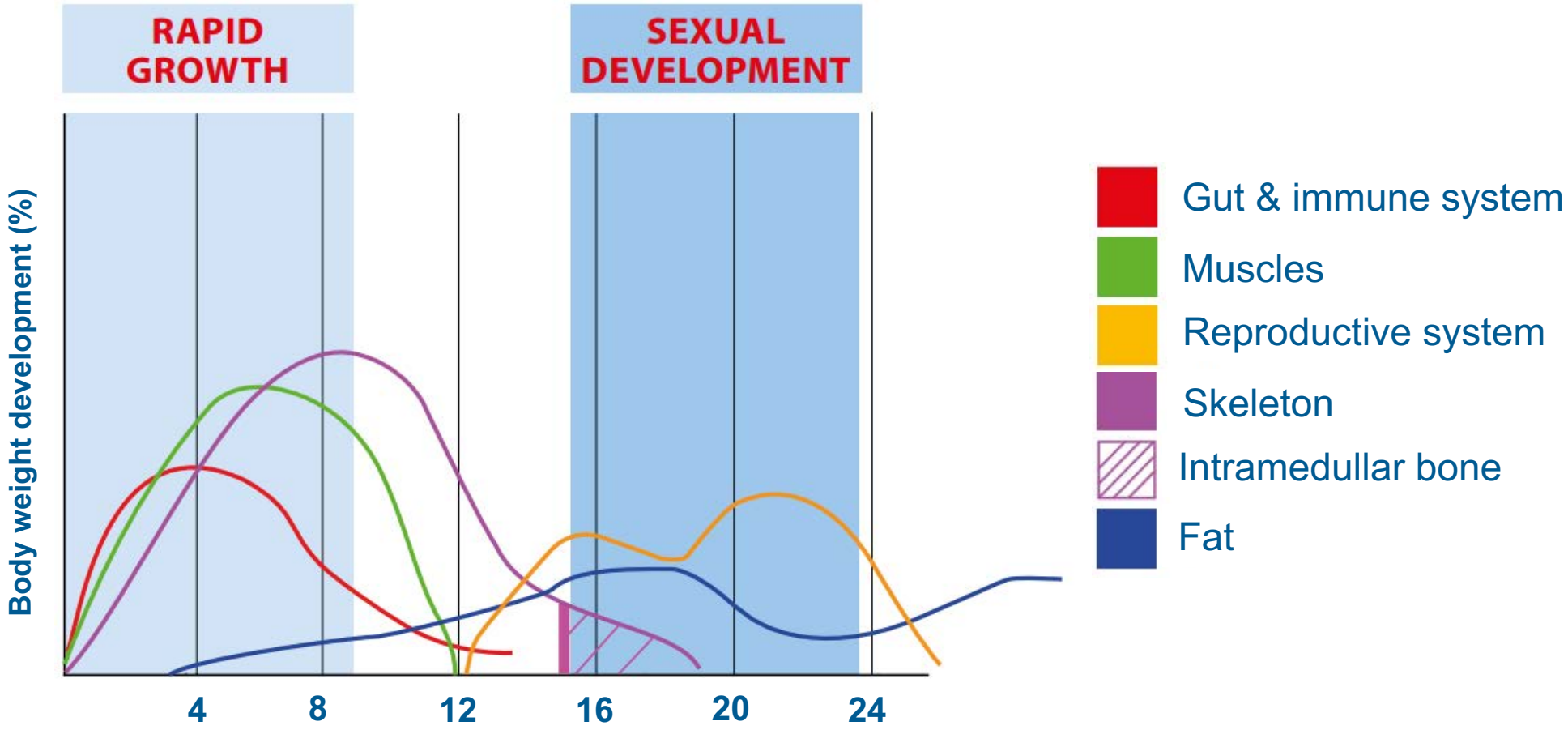
Expression of mRNA for Th2 cytokines following oral infection with 1000 Ascaris galli worm eggs



Degen, Daal and Schijns 2004

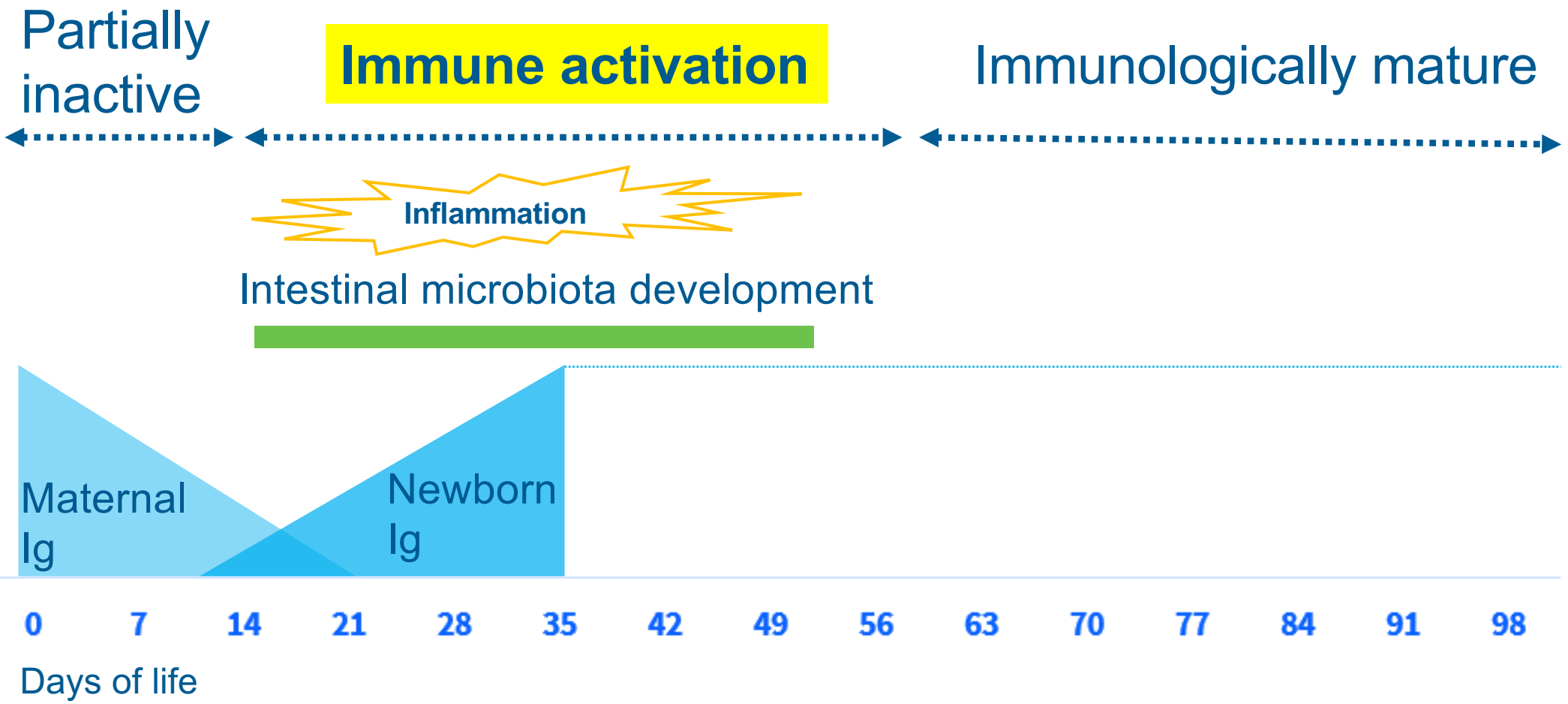
The immune system development

Critical weeks



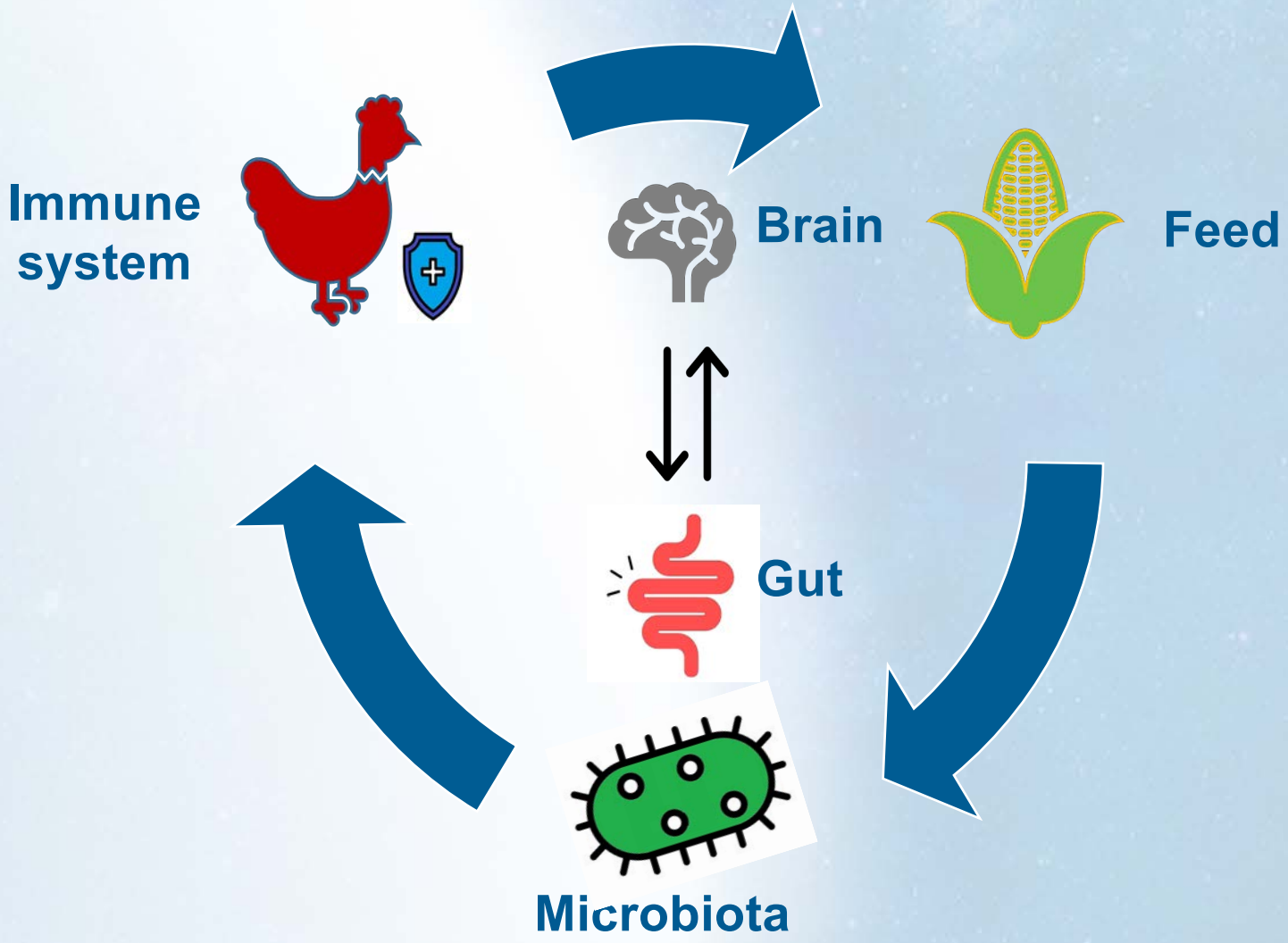
The immune system development

Maturation of adaptative immunity



The immune system

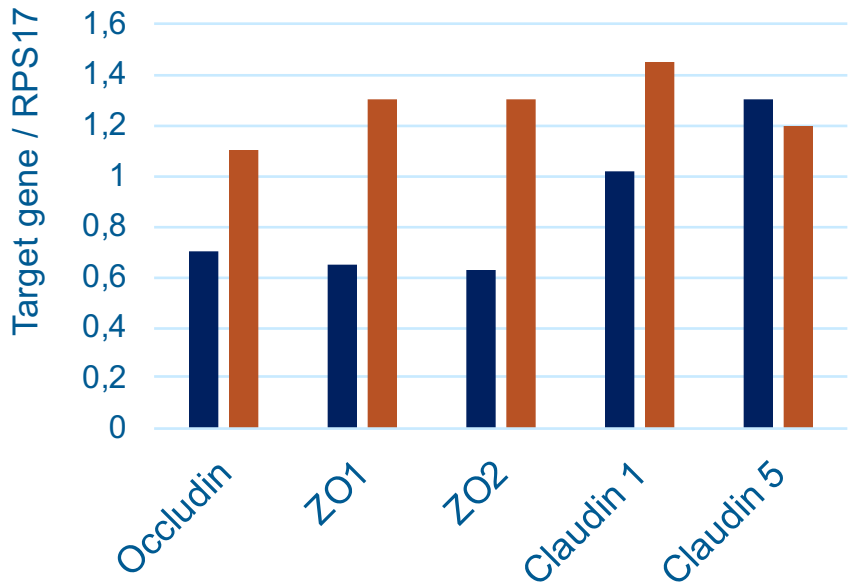
Extended version



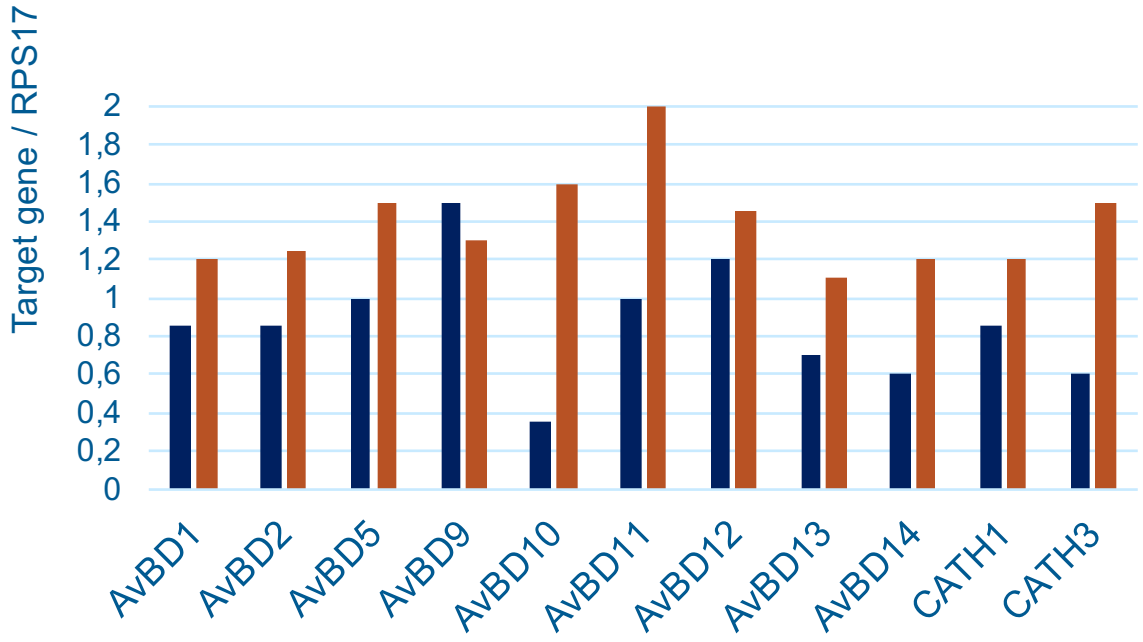
Immune system in aged birds

Age-related modulation of the uterine mucosal innate immunity in white laying hens

Cell tight junctions



Innate immunity proteins

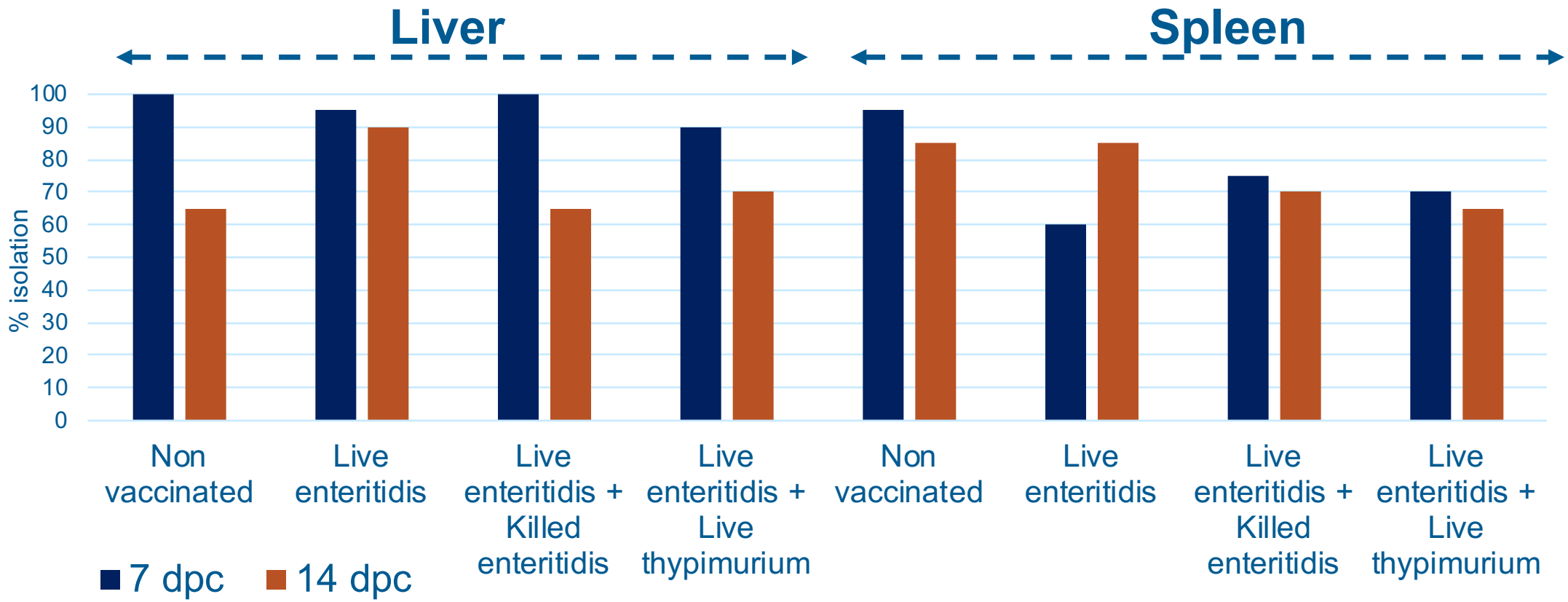


Young hens (35 weeks old) Old hens (130 weeks old)

Elhamouly 2019

Immune system in aged birds

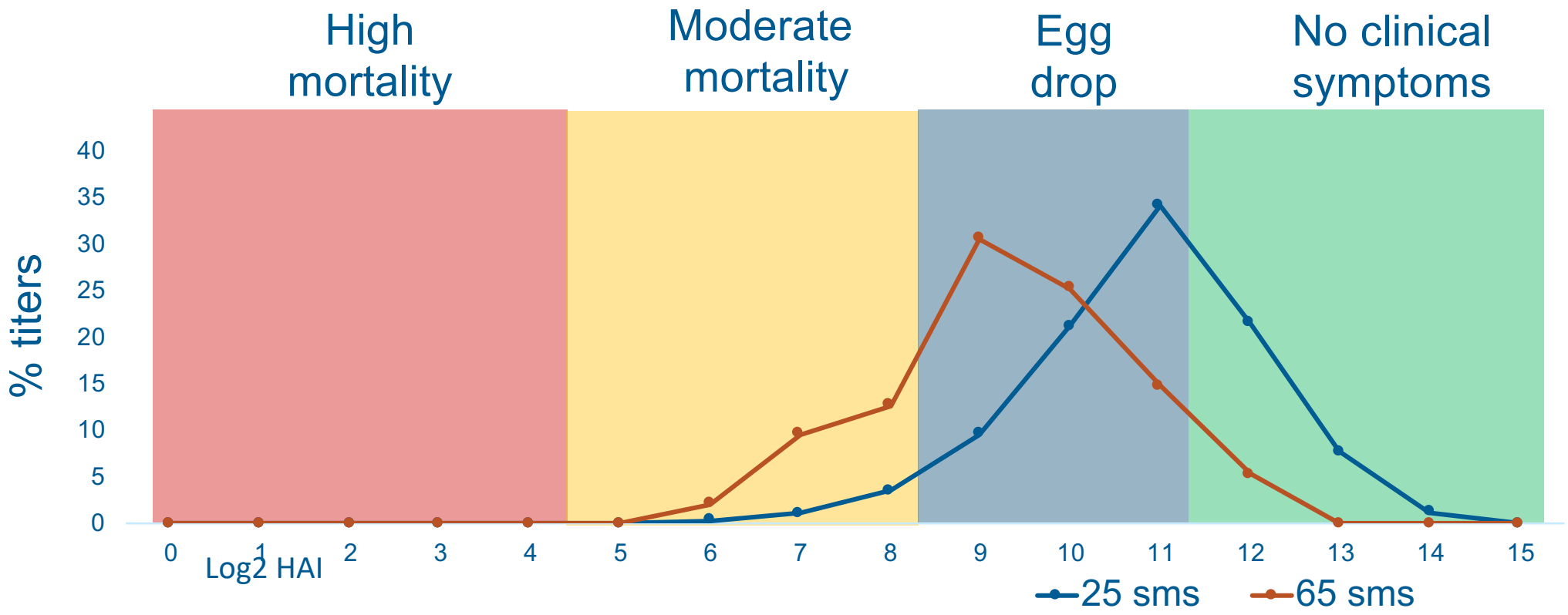
S. Enteridis isolation after challenge (10^9 CFU) in 85-weeks-old laying hens with different vaccines



Reep 2019

Immune system in aged birds

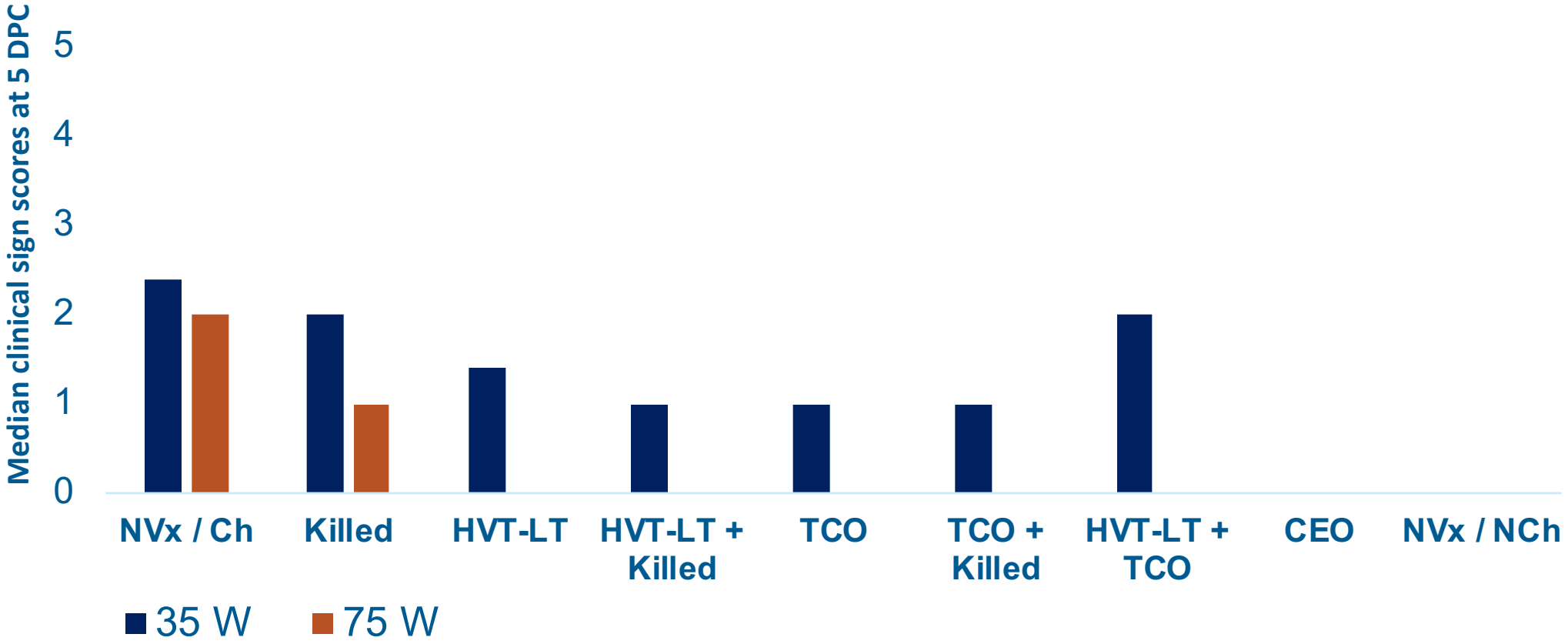
ND antibody titers distribution from 2M layers Spanish operation



2-3 live vaccine + 1 killed @ rearing.
No revaccination @ production

Immune system in aged birds

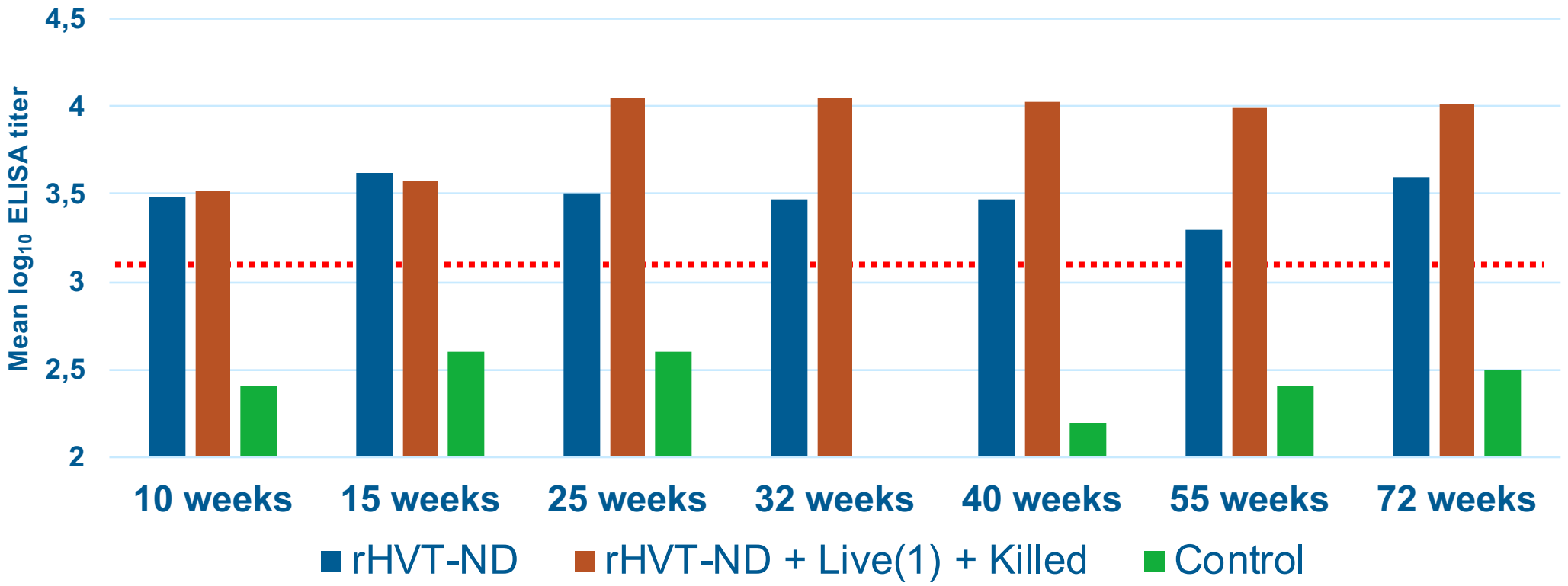
Protection against ILT virus induced by different vaccines program in young and old laying hens



Palomino-Tapia 2019

Immune system in aged birds

Detection of humoral immune response to different vaccination programs against Newcastle diseases

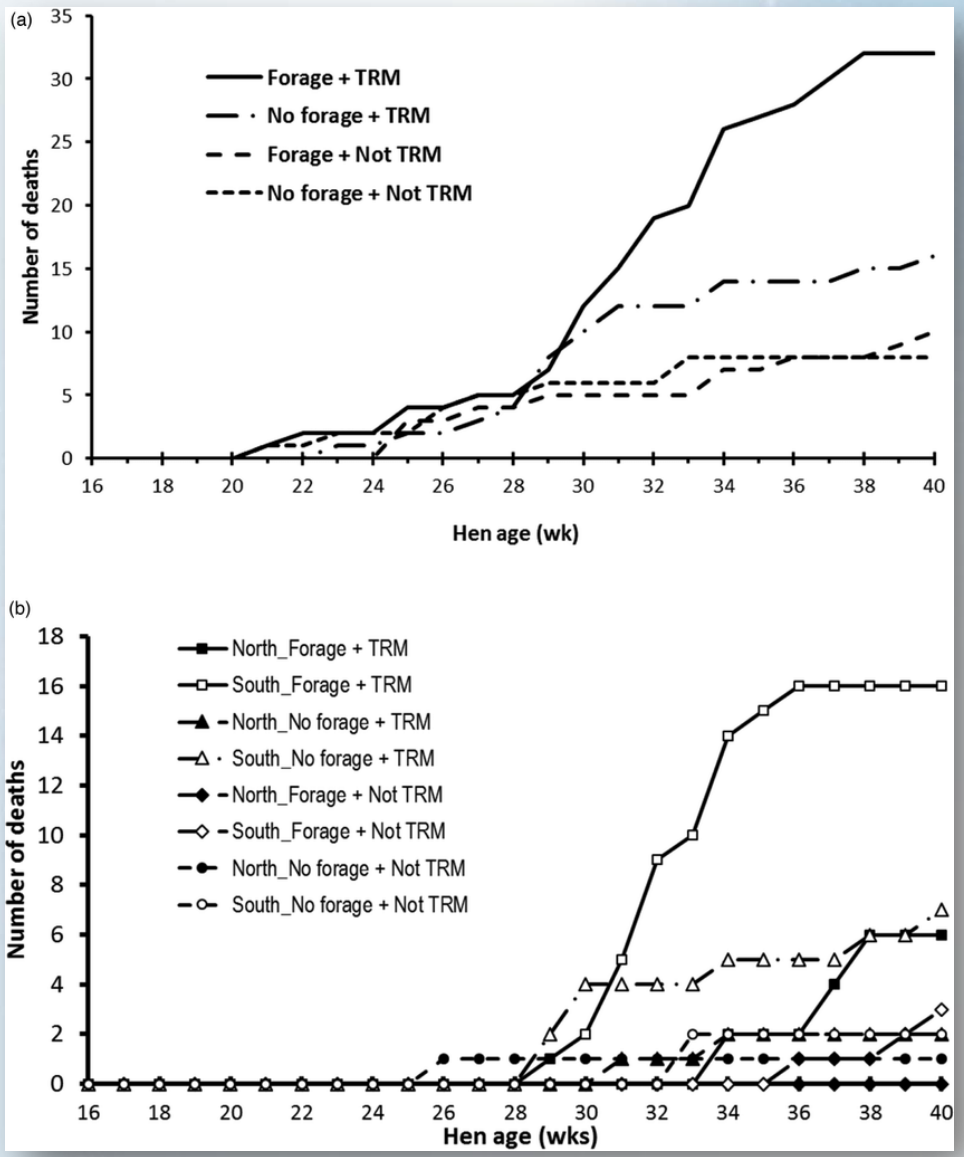


Palya 2014

A The **development** of the immune system during the **first 8 weeks** of the chick's life **has an effect** on **acquired immunity** later on.

B **Innate immunity** is **not programmed** to **be inactivated** in hens older than **60 weeks.**

C Depending on the different diseases and types of vaccines, **re-vaccinations** may be necessary to **maintain good specific immunity** in extended cycles



So, why do we observe such an increase in mortality in older hens?

Failures in immunity

Factors leading to immunosuppression

Diet -induced

- Unbalanced diet
- Long-term feed restriction

Stress -induced

- Temperature
- Social
- Environmental

Toxic- induced

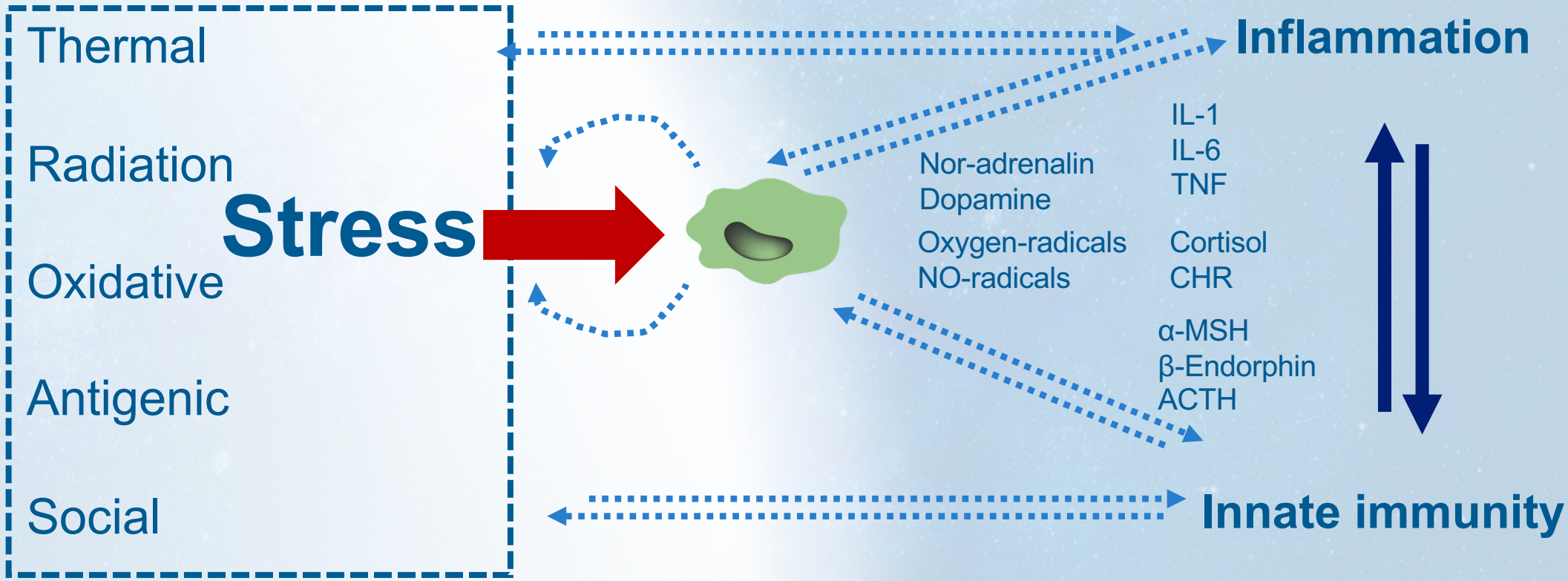
- Mycotoxins
- Pesticides
- Organochlorine compounds

Disease induced

- Coccidia
- IBD, CAV, REO, MD, ALV-REV

Stress-induced immunosuppression

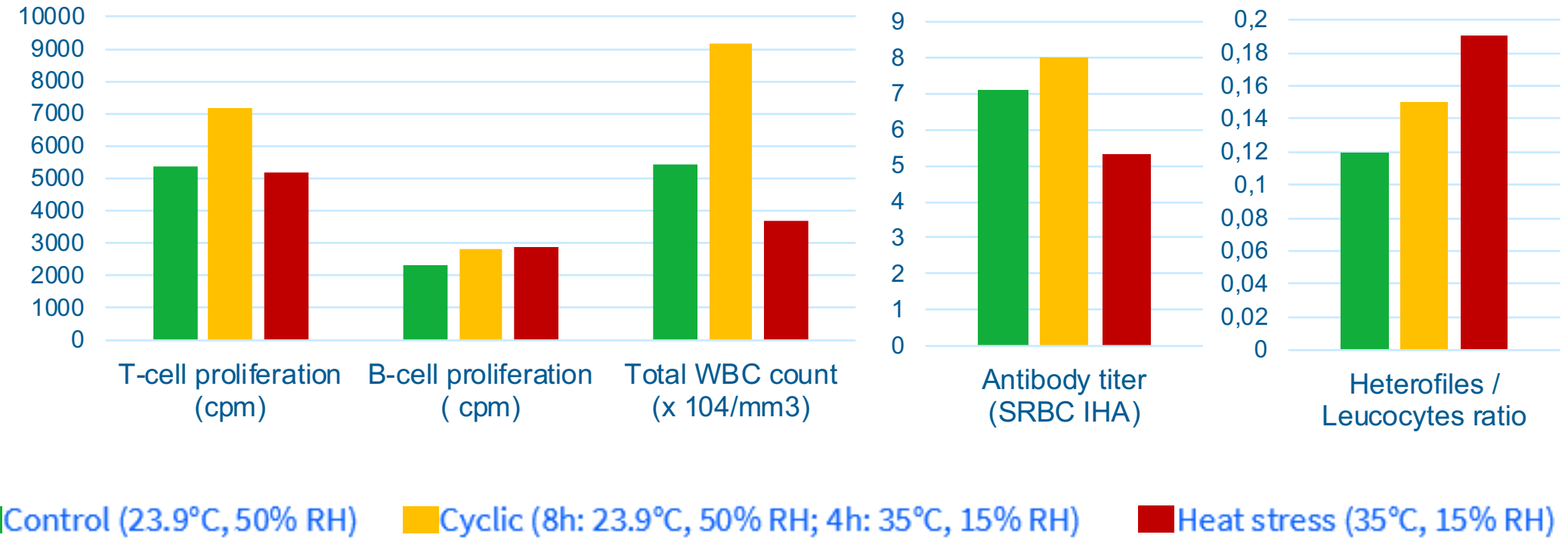
Inflam-agging theory in humans



Franceschi et al 2000

Stress-induced immunosuppression

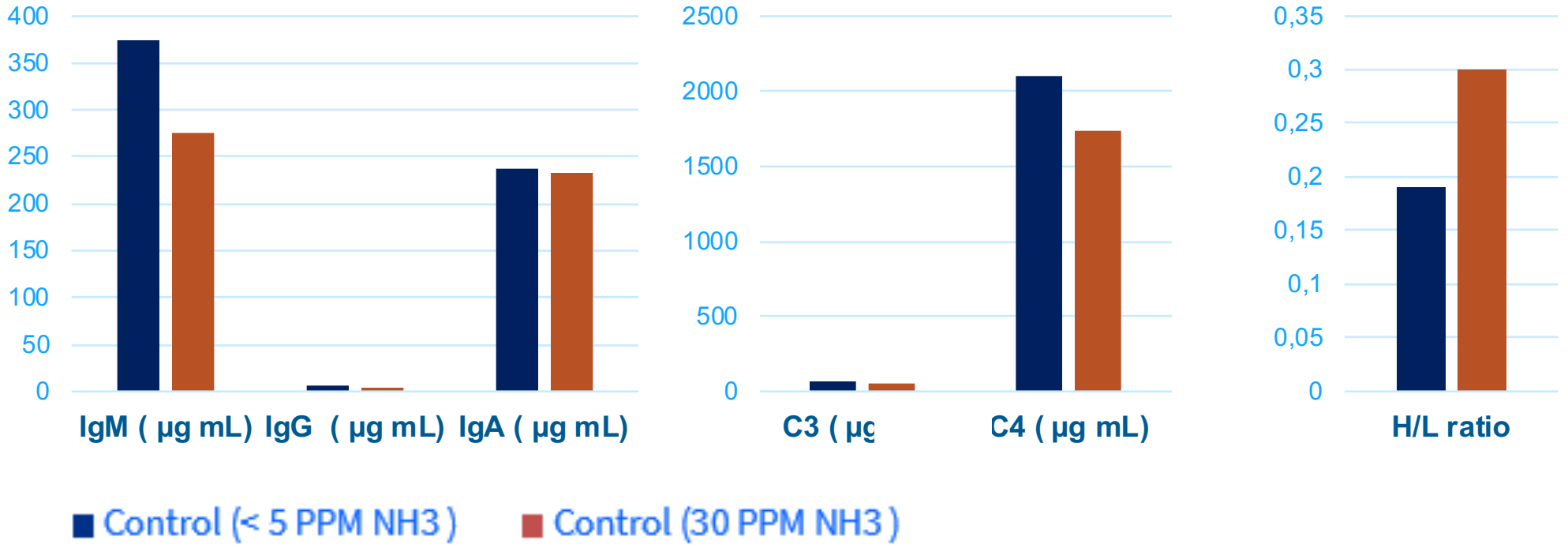
Effect of heat stress for 4 weeks on different immunological parameters in 35-week-old hens.



Mashaly 2004

Stress-induced immunosuppression

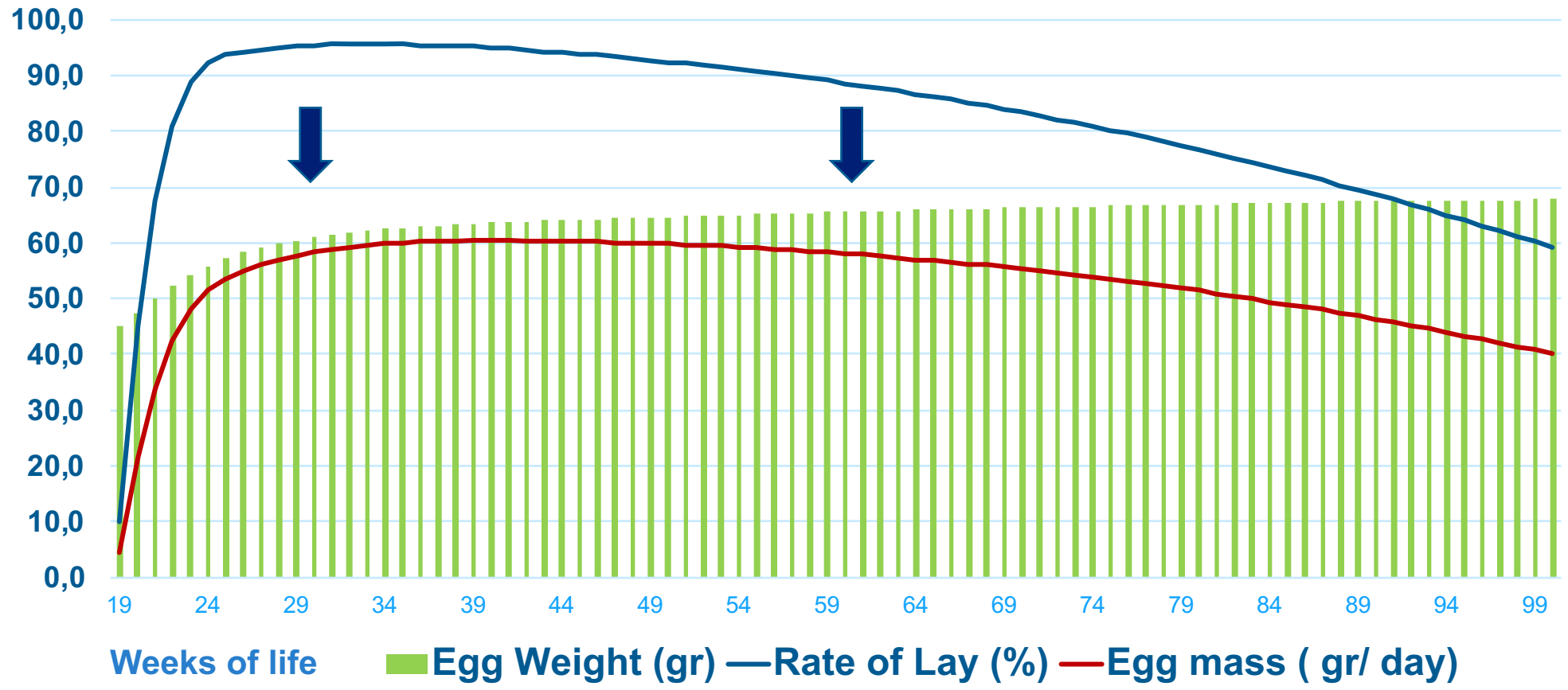
Immune Response of laying hens exposed to 30 ppm ammonia from week 25 to week 50



Chen 2017

Diet-induced immunosuppression

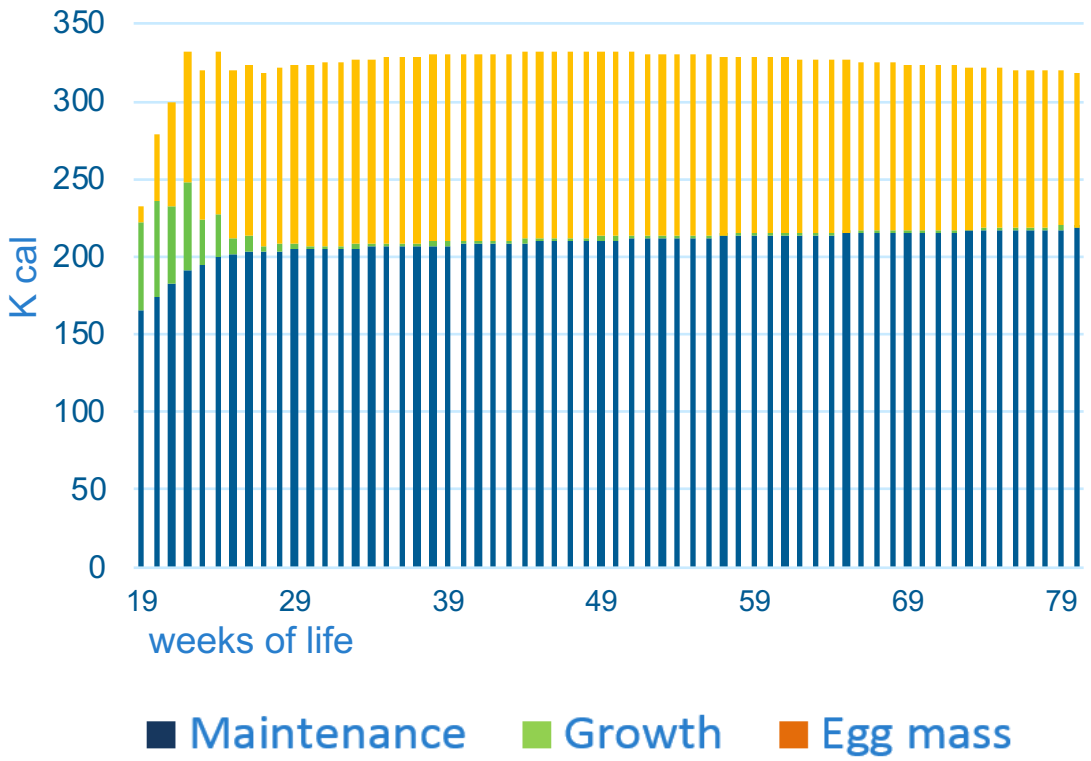
Egg mass production (Brown layer)



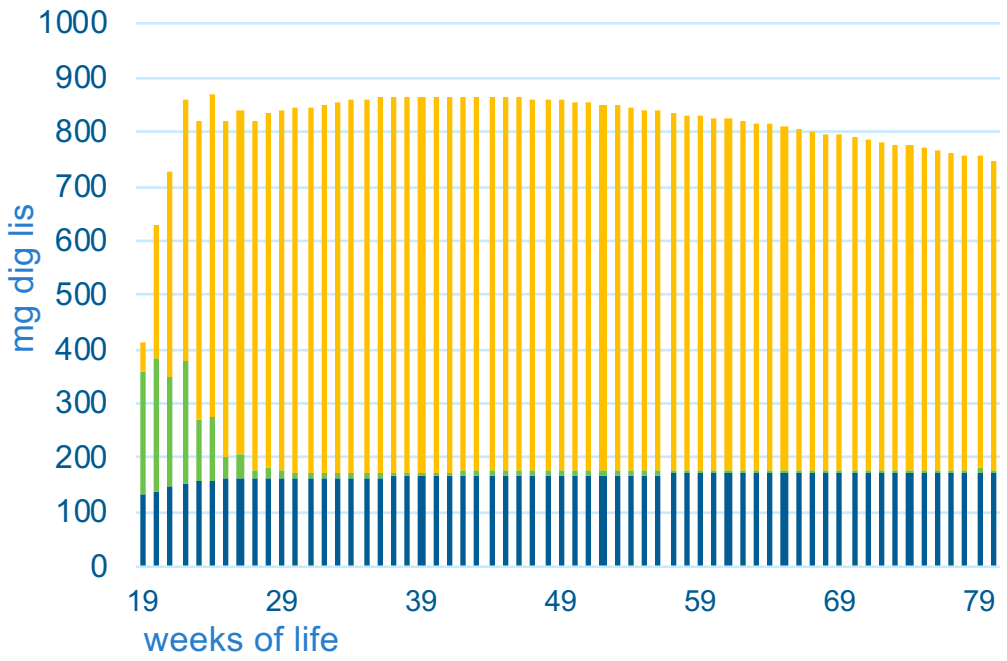
Diet-induced immunosuppression

Nutrient requirements (Brown layer)

Energy

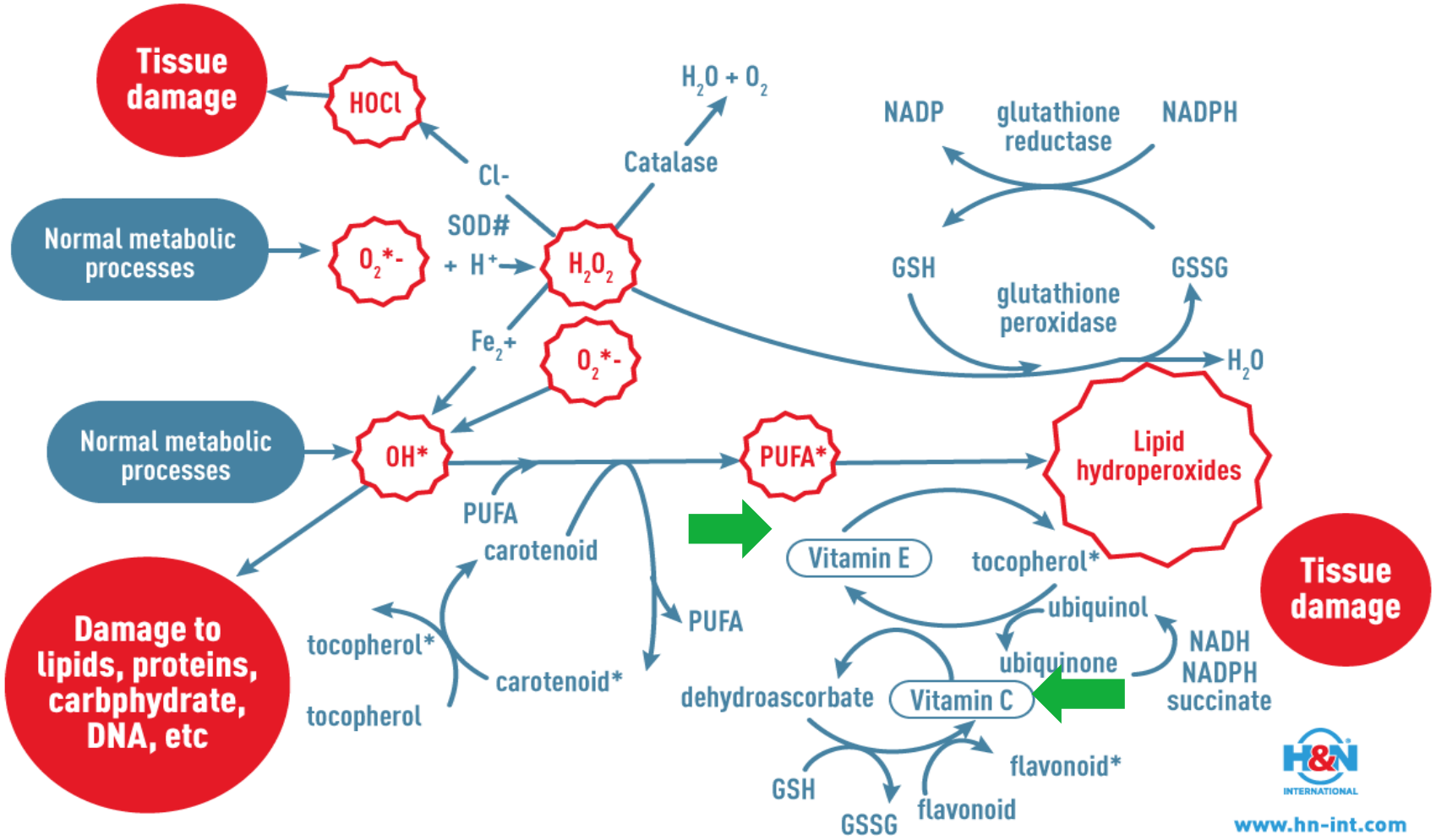


Amino acids



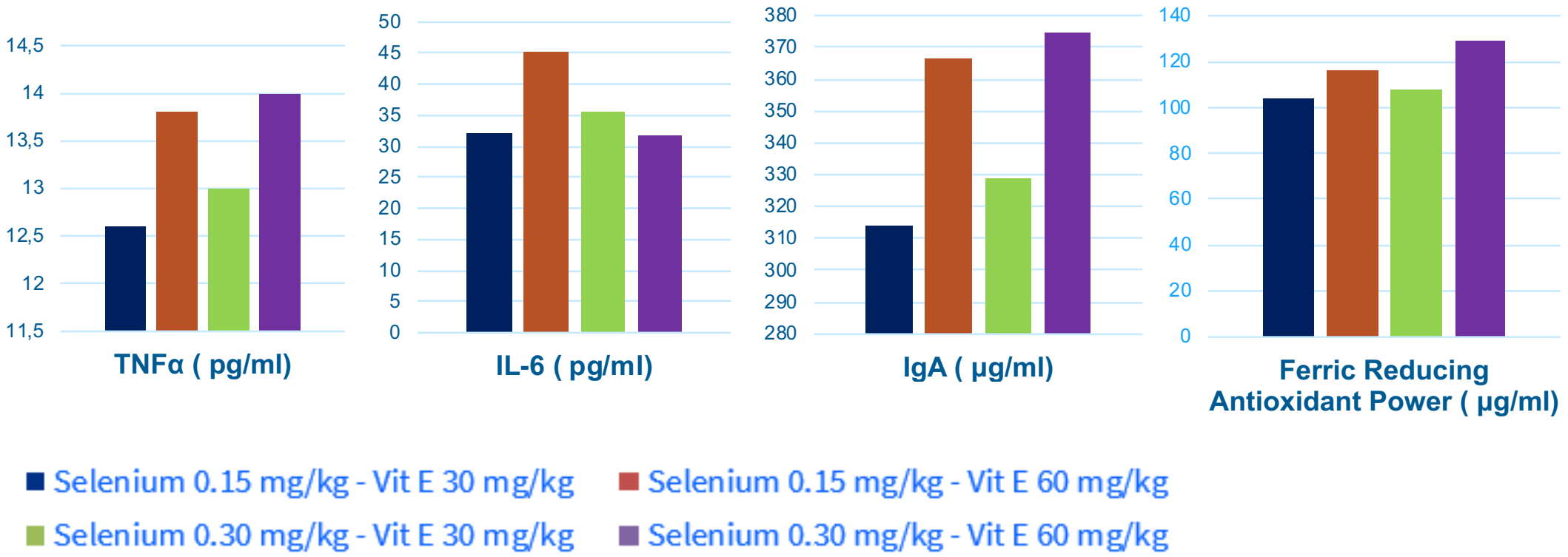
Diet-induced immunosuppression

Oxidative stress



Diet-induced immunosuppression

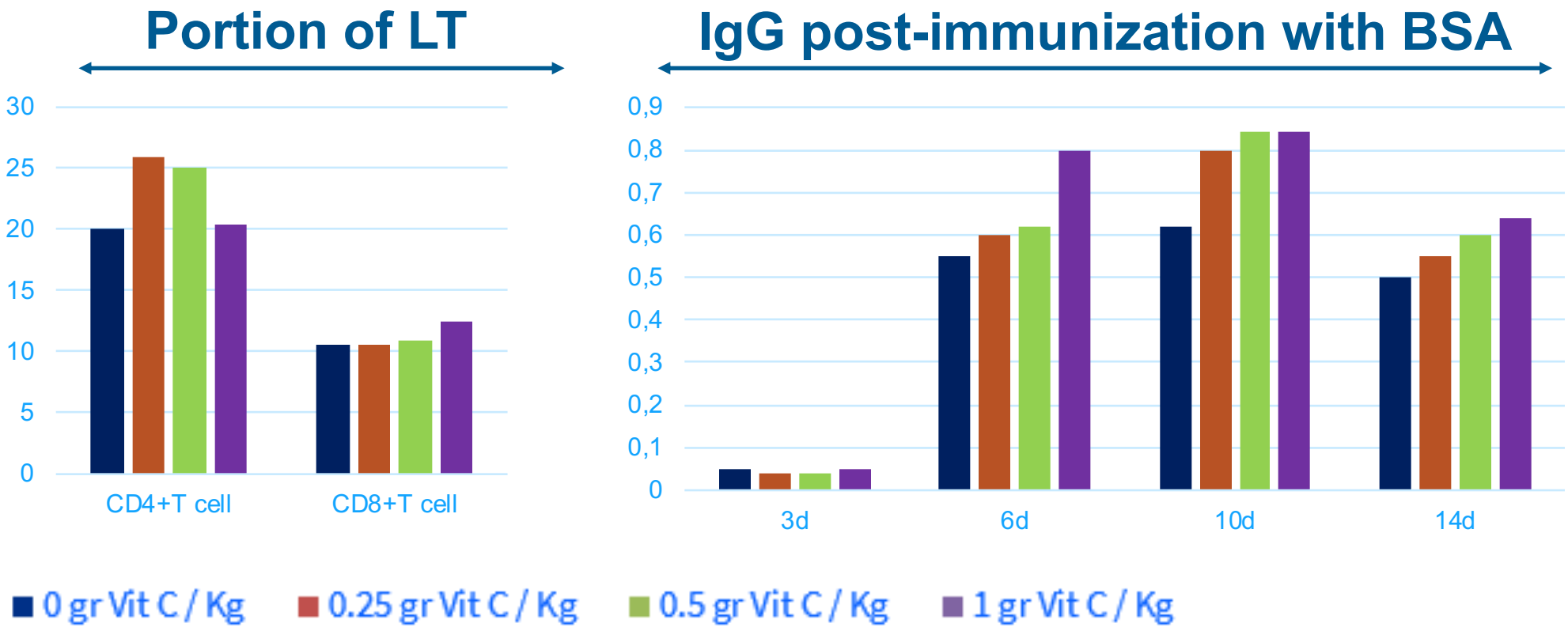
Effect of different dietary levels of vit E and Se on serum markers related to antioxidant and immunological status



Zduńczyk 2013

Diet-induced immunosuppression

Effects of 8-weeks dietary Vit C supplementation on immunity markers in 78-weeks-old laying hens



Gan 2018

A

Mycotoxins and **immunosuppressive diseases control** is a **prerequisite** for good immunity at early and late production period.

B

Stress of whatever origin can **exhaust** the immune system. Particular attention should be paid to **diet /egg mass imbalances**.

C

Certain **vitamins** and **minerals** can play a **key role in lessening** the impact of oxidative stress and other types of stress.

A

Longer production cycles can be achieved by laying hens but **long-lasting and protective immunity** during the whole cycle is required

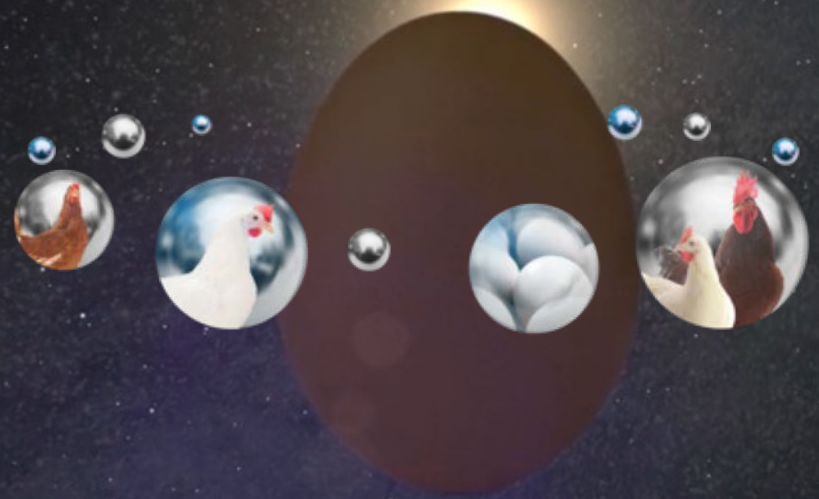
B

Good management is critical to **avoid chronic stress** that can lead to an **immune system deterioration** during the production cycle.

C

More research on late-stage immunity of hens is needed. More **immunological products adapted and licensed** for this period as well.

Thank you for your attention



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