

Histomonosis and the differential survival of poultry species

Learning Lessons from
the Chicken

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Introduction

Histomonas and differential survival

- Disease: **Histomonosis** (“Blackhead”)
- Pathogen: ***Histomonas meleagridis***
(flagellate-amoeboid protozoan parasite)

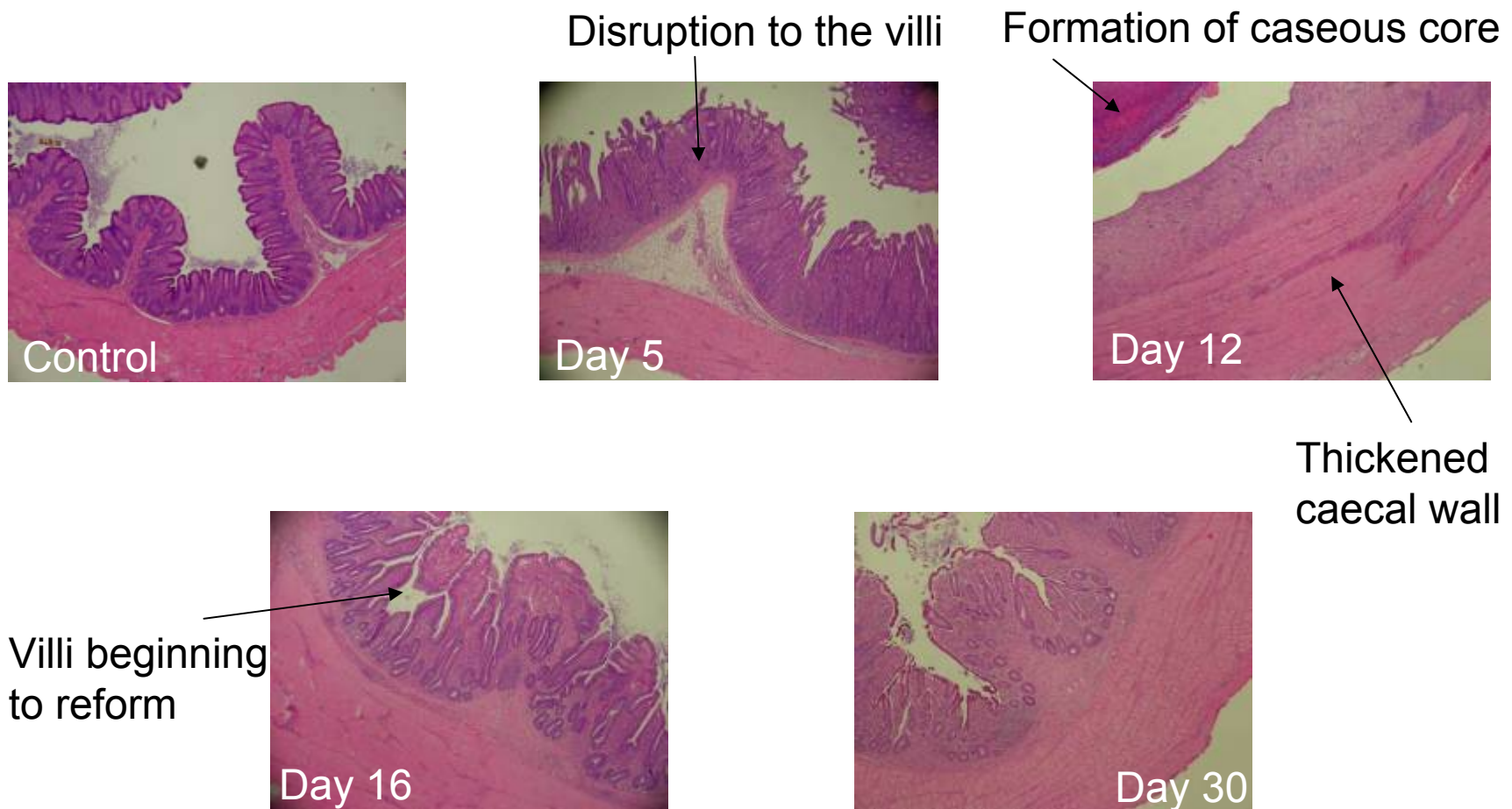
- Spectrum of disease outcome:
 - **Chickens** are **resistant**
 - **Turkeys** are **susceptible**



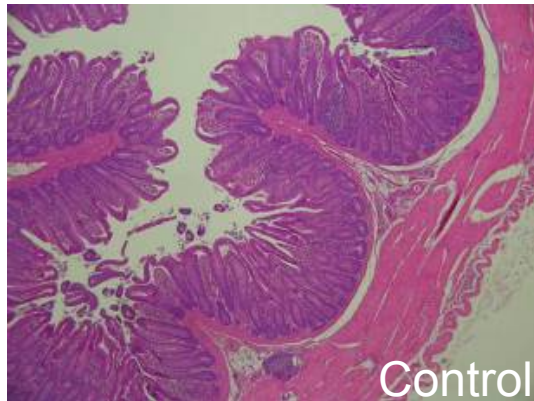
Introduction: Caeca



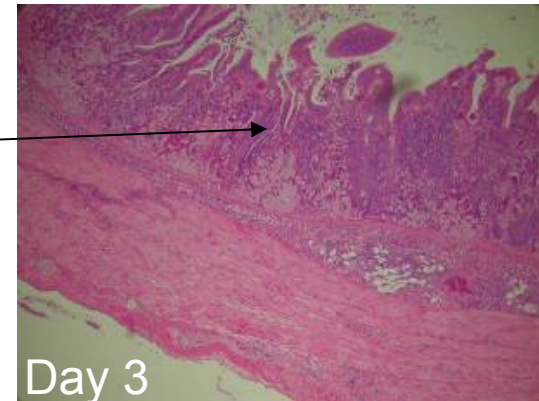
Introduction: Chicken caeca



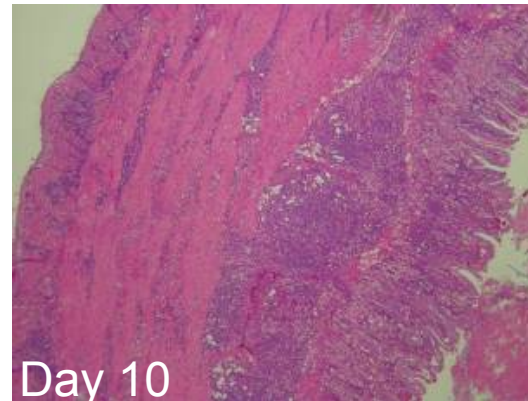
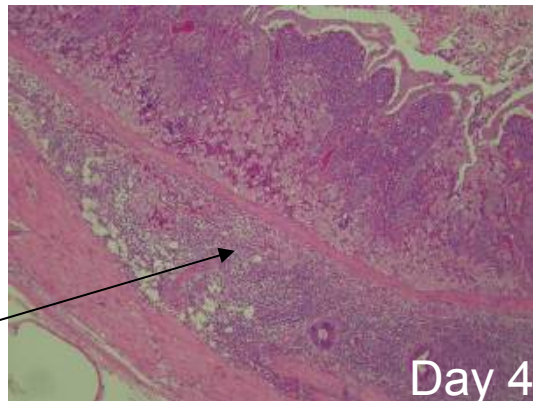
Introduction: Turkey caeca



Caecal structure disrupted as histomonads invade and lesions develop

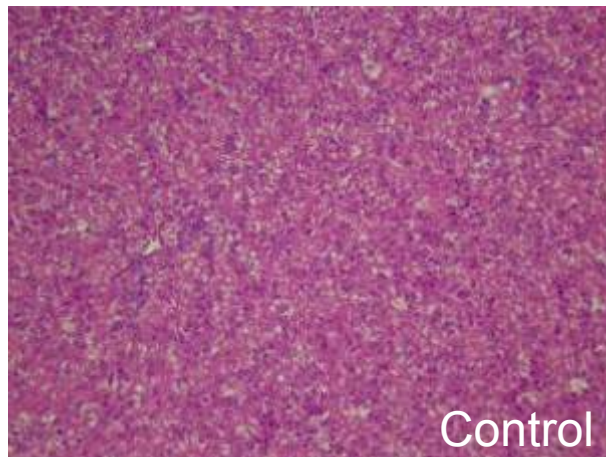


Caecal wall thickened, hard caecal core



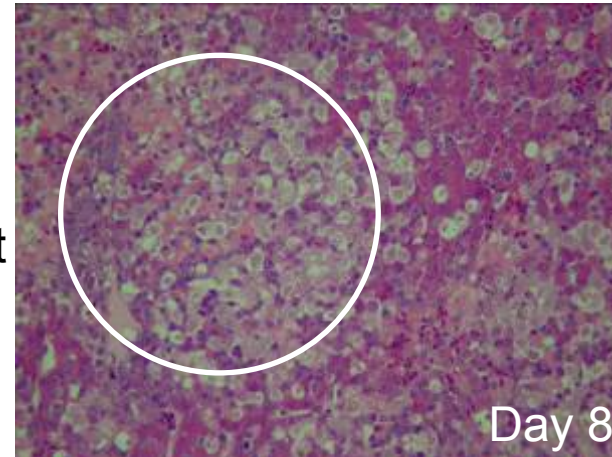
No caecal lesion healing

Introduction: Turkey liver



Control

Necrotic foci
development



Day 8

Introduction

Histomonas and differential survival

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 - Spectrum of disease outcome:
 - **Chickens** are **resistant**
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 - Why such differing outcomes from two evolutionary closely related species?
-

Introduction

History

- 1895: Discovered – Smith
 - *Amoeba meleagridis*

 - 1920: Classified – Tyzzer
 - *Histomonas meleagridis*
 - Main cause of loss to turkey industry

 - 1950: Development of therapeutics
 - Decline in outbreaks

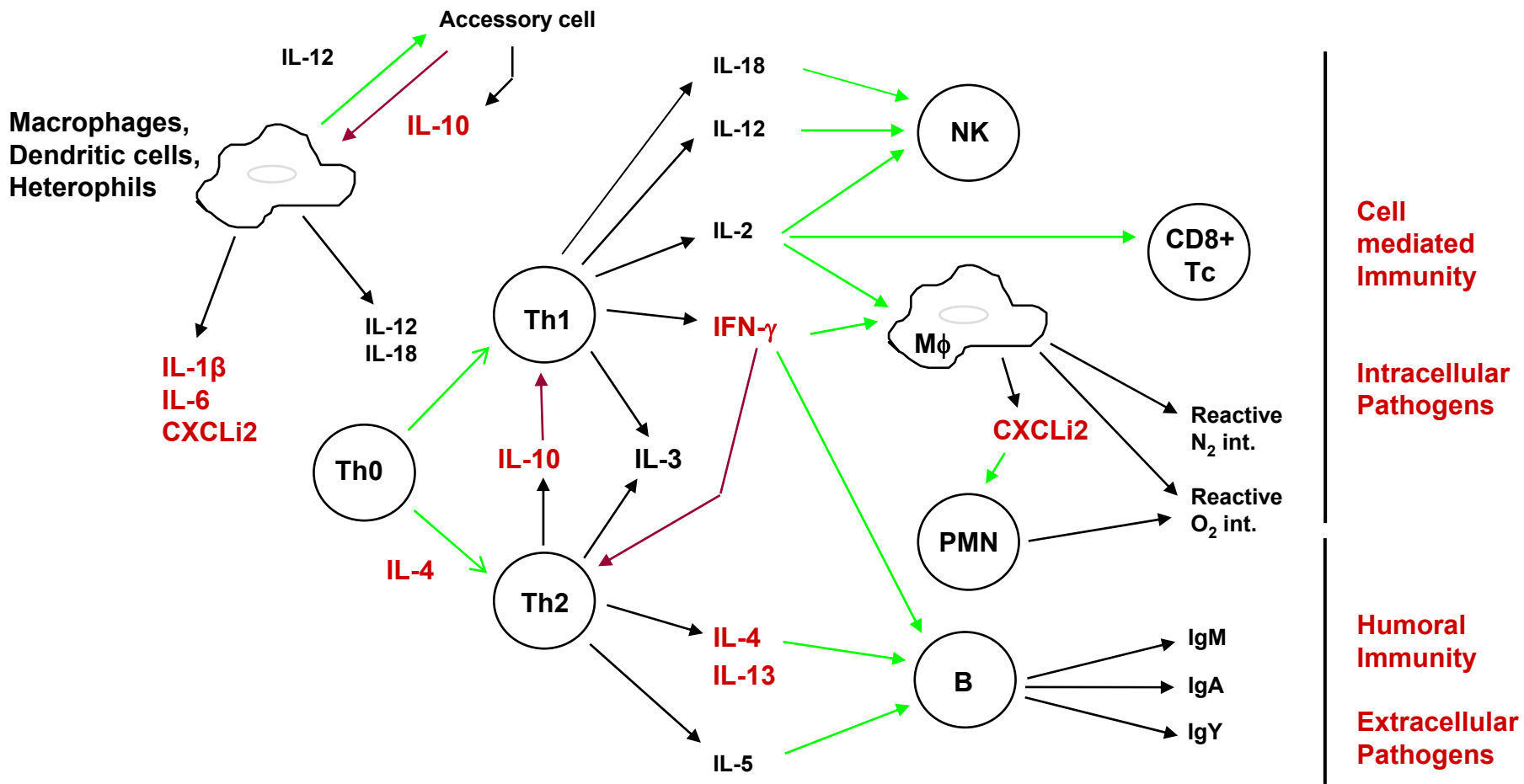
 - 1995-present: EU ban nitroimidazole treatments
 - Farming practice moves to free-range
 - Increasing outbreaks across Europe
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Aims

- To determine if the immune response contributes to the differential survival of poultry infected with *Histomonas*
 - The chicken provides a model of resistance to which the turkey can be compared
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INNATE

ADAPTIVE



Chicken and turkey infections with *Histomonas meleagridis*

Characterising the immune response

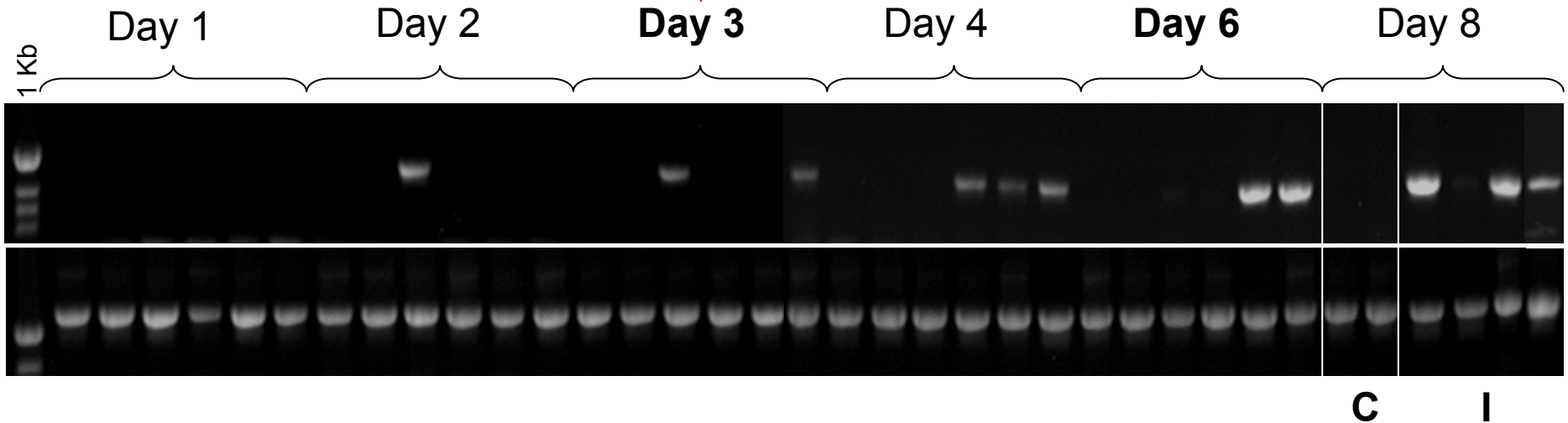
Experimental Approach

- **Experimental infections:** of chicken and turkey
 - **RT-PCR & real-time qPCR for ribosomal subunit**
 - **Real-time qRT-PCR:**
 - Pro-inflammatory Innate: IL-1 β , IL-6, CXCLi2
 - Adaptive: IFN- γ (Th1); IL-4, IL-13 (Th2)
 - Regulatory: IL-10, TGF- β 4
 - β -Defensin: Gallinacin 2 (Gal2)/Turkey heterophil peptide 2 (THP2)
 - **Immunohistochemistry:**
 - CD4, CD8 α , CD28, CD44, MHC-II β chain, B cells
 - **ELISA**
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Chicken - Caecal Tonsil

1st caecal lesions observed

Caecal core development



Most severe lesions

Caecal healing evident

Mucosa almost normal, large cores

3/4 birds normal

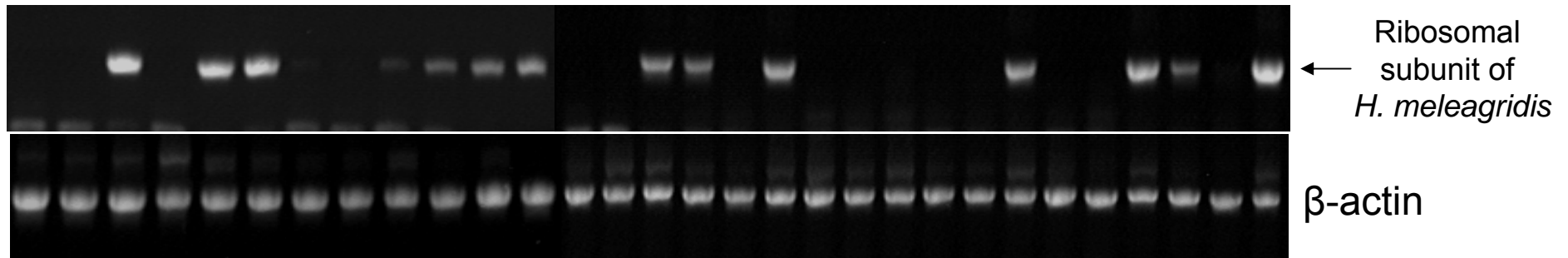
Day 10

Day 12

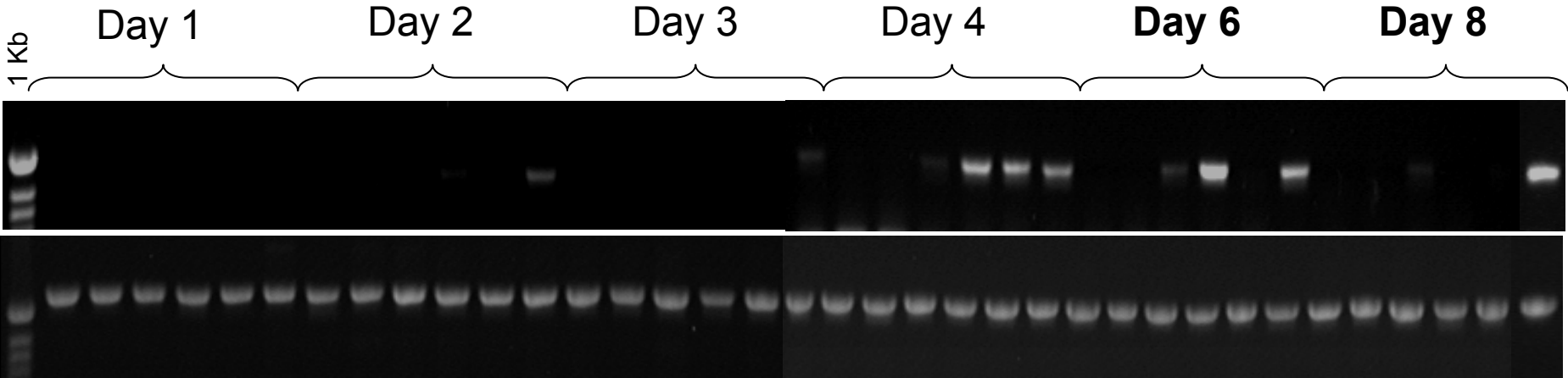
Day 18

Day 24

Day 30

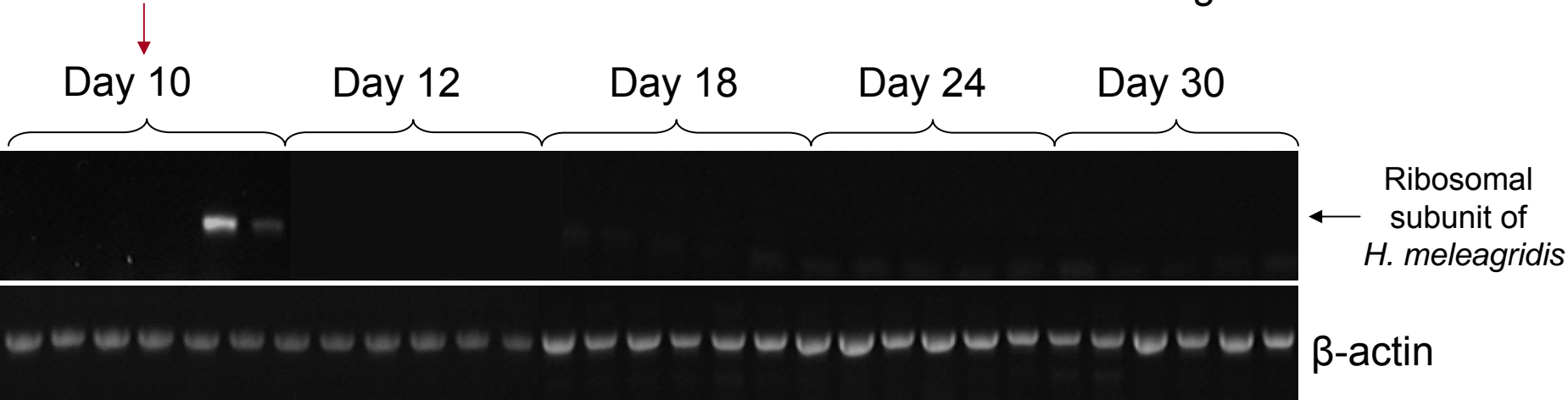


Chicken - Liver

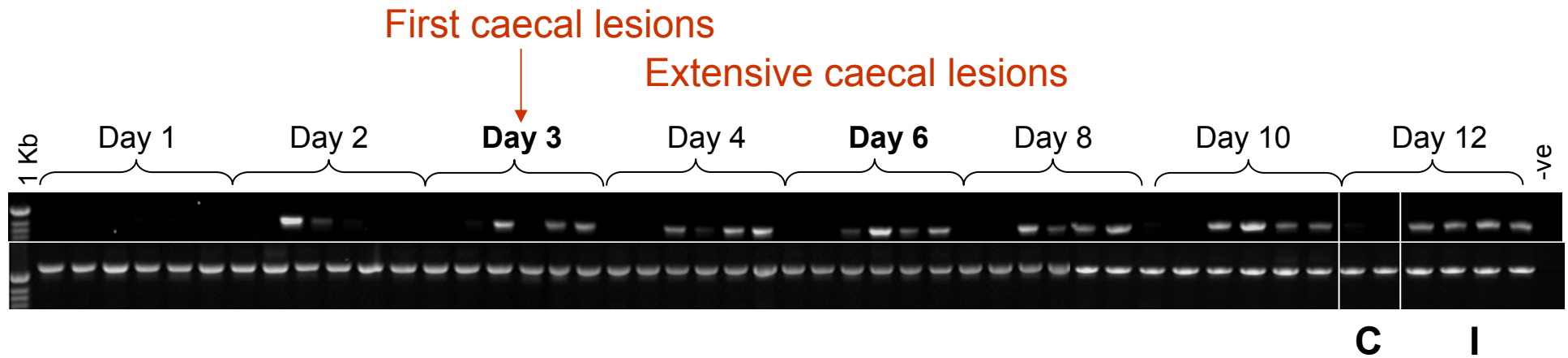


Lesions observed
in one bird

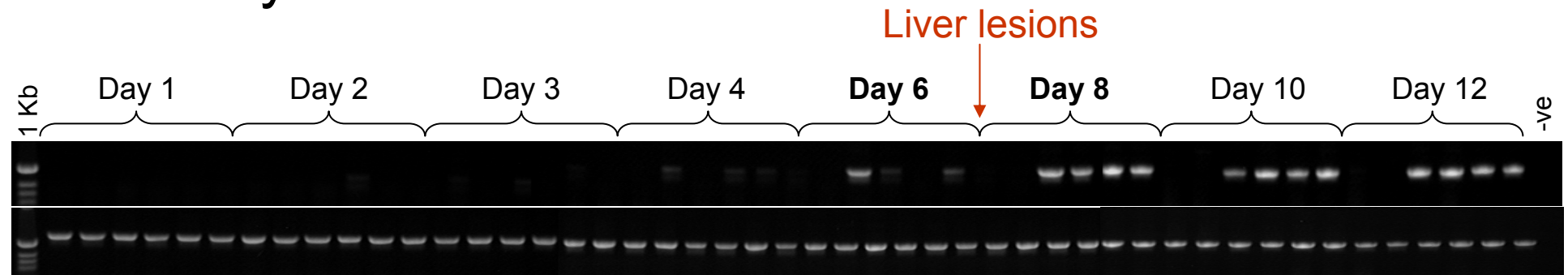
Histomonads only observed in
2 birds during initial infection



Turkey - Caecal Tonsil

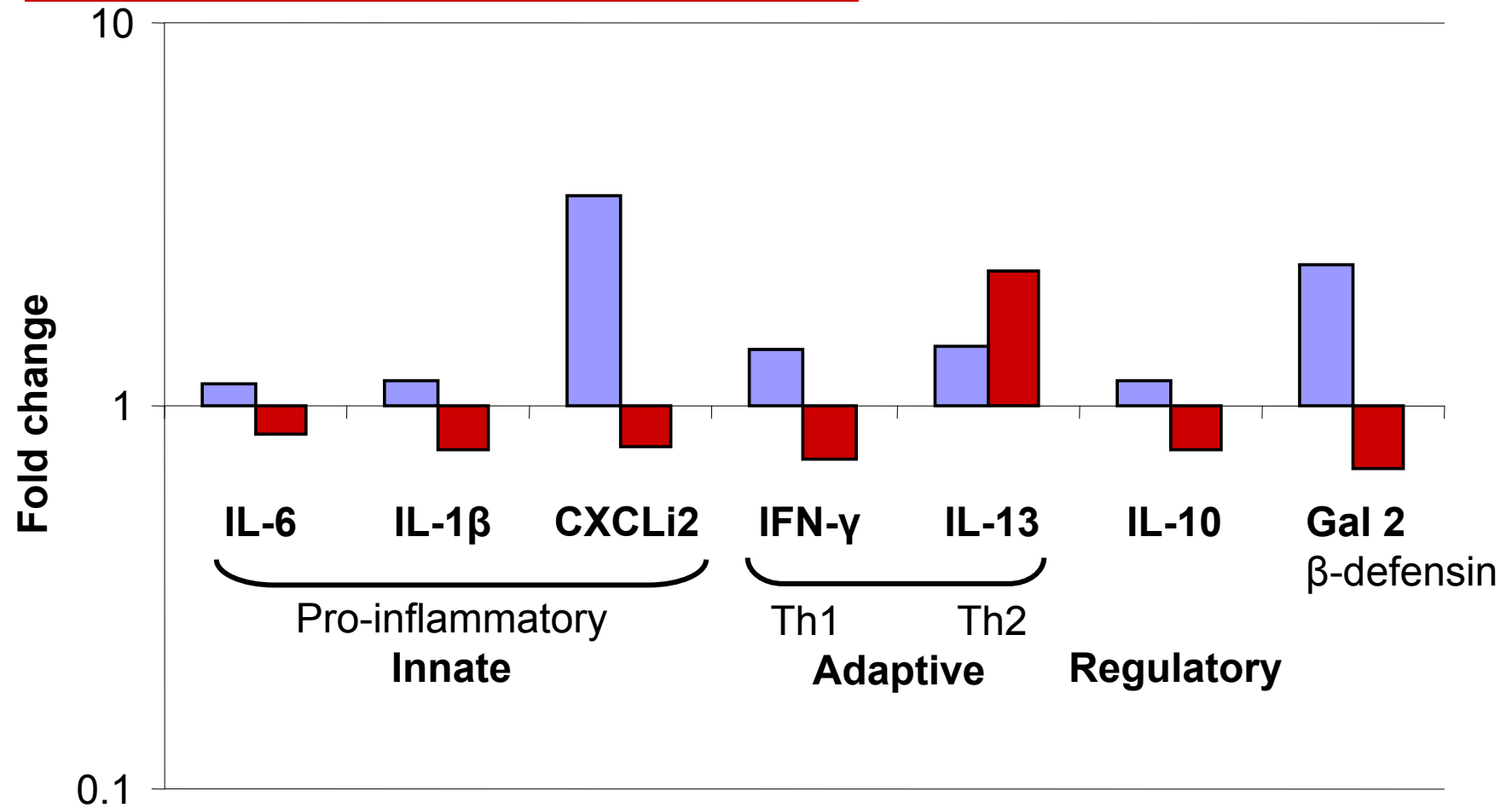


Turkey - Liver



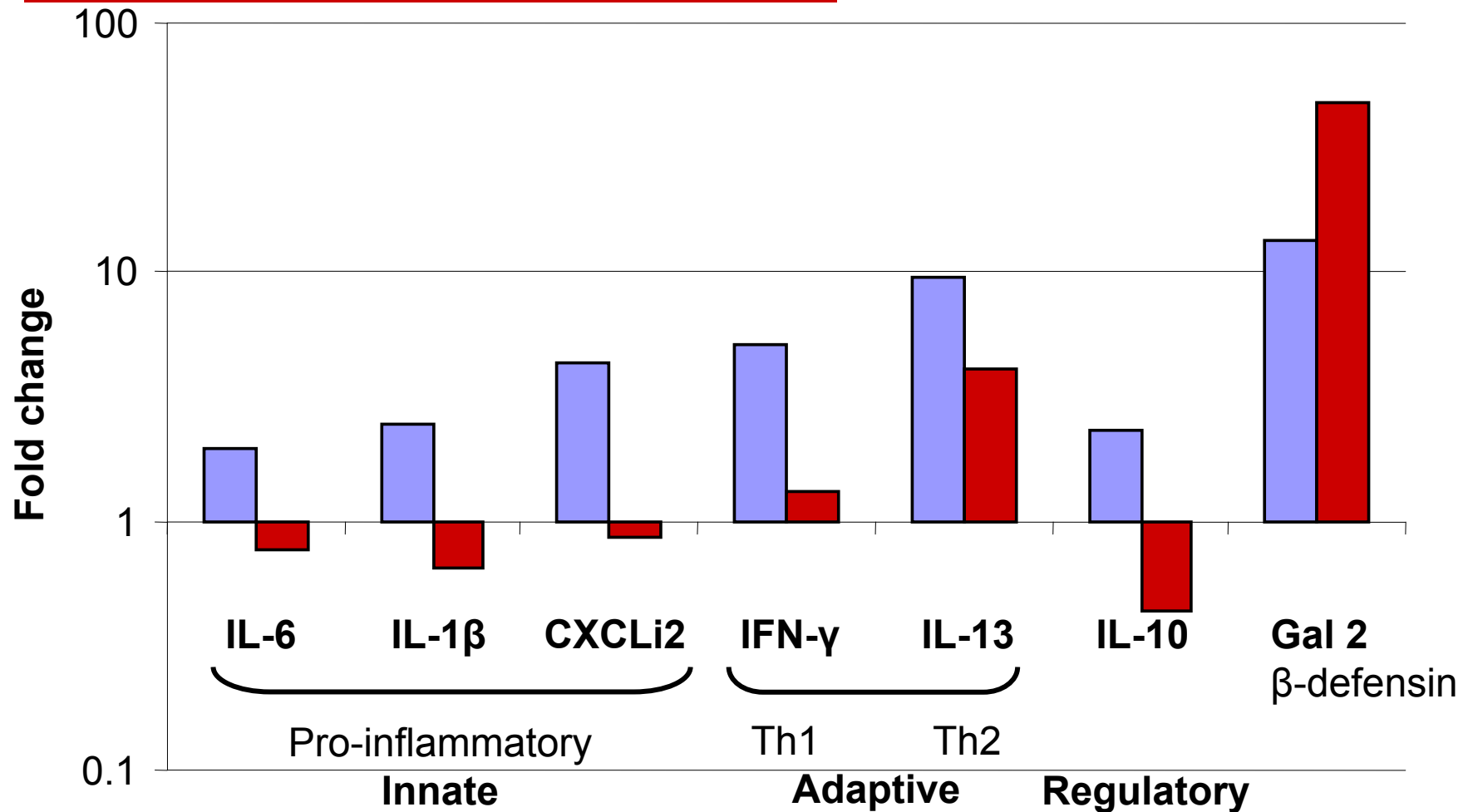
Caecal tonsil: day 3

Chicken
Turkey



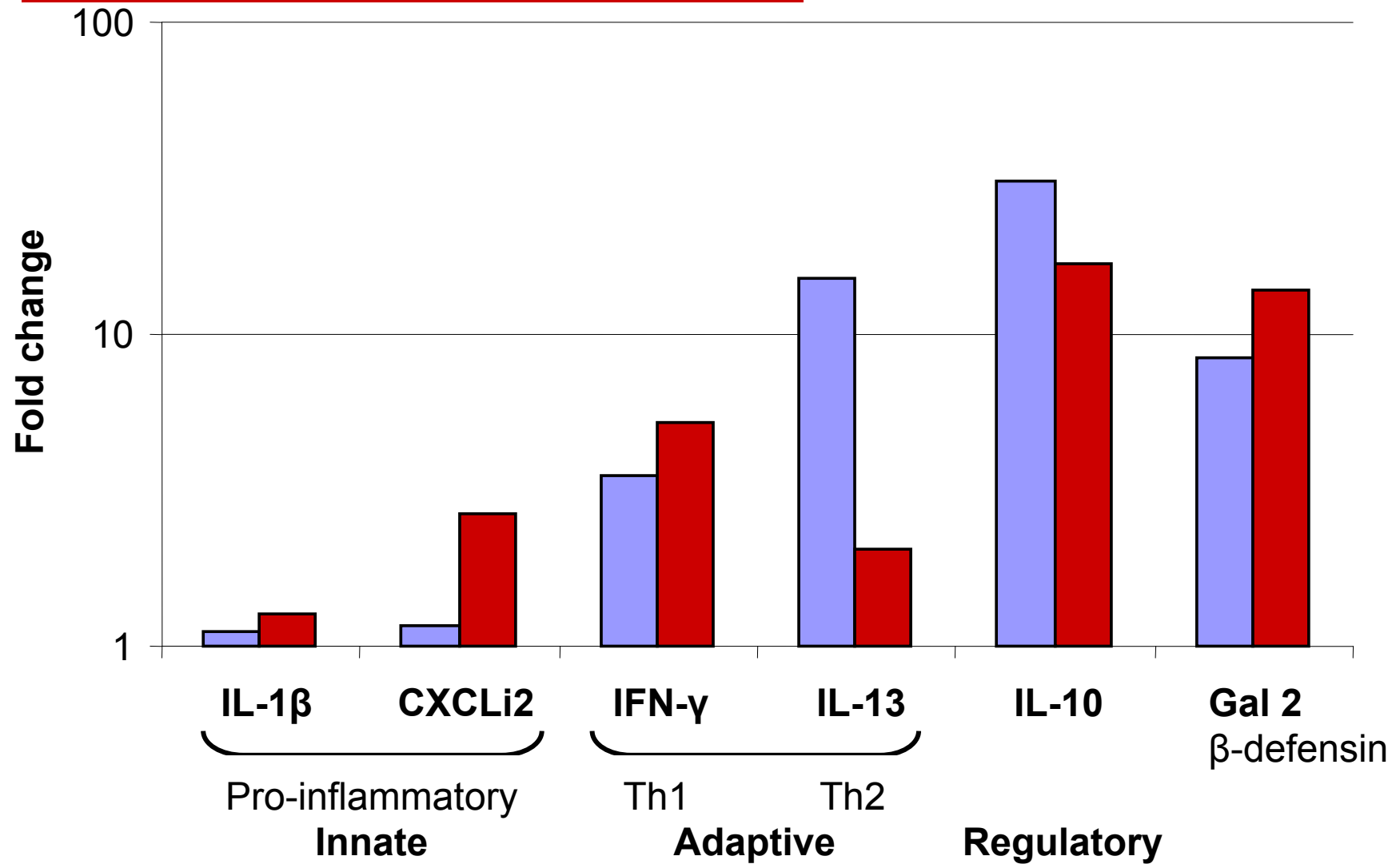
Caecal tonsil: day 6

Chicken
Turkey



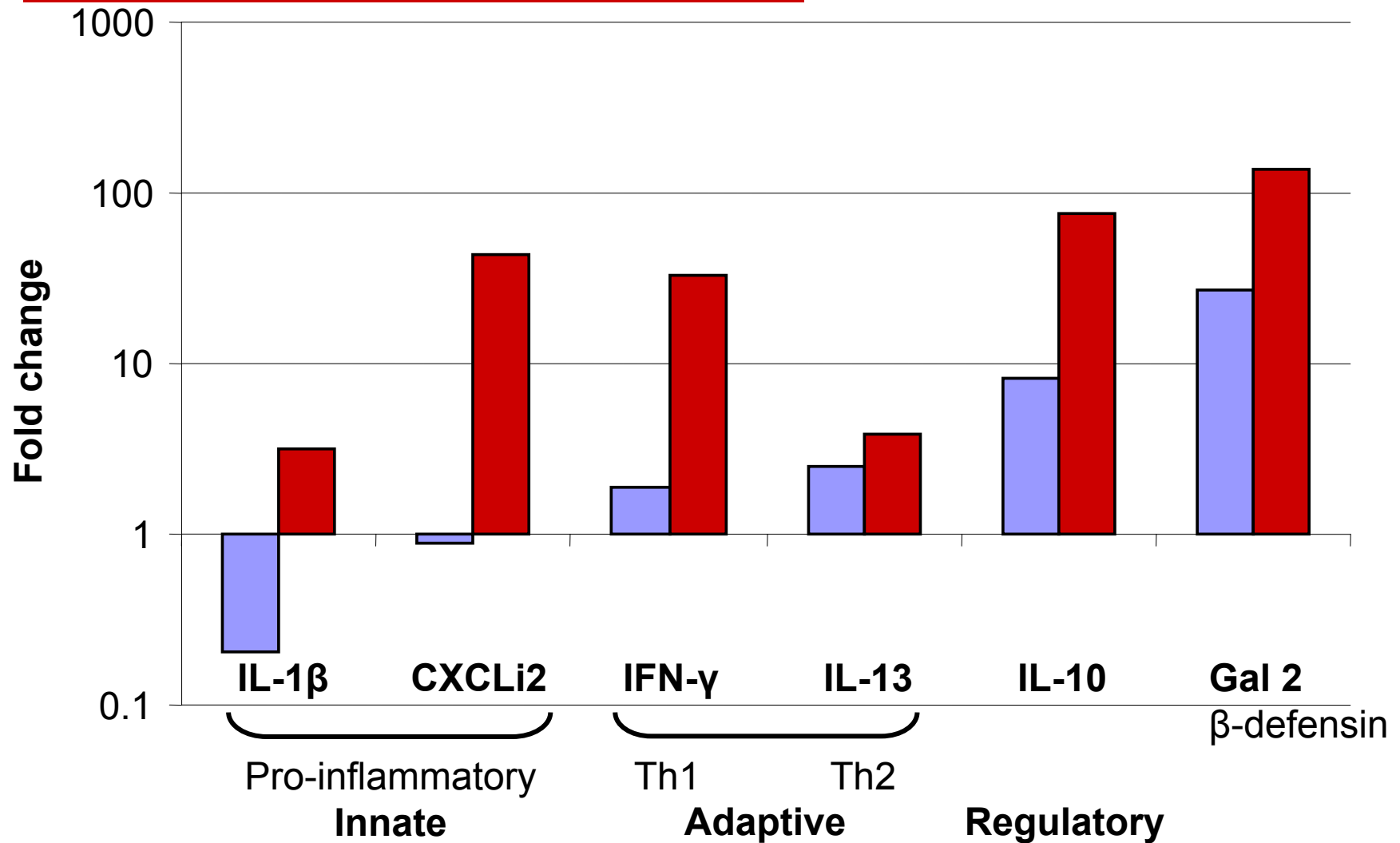
Liver: day 6

Chicken
Turkey



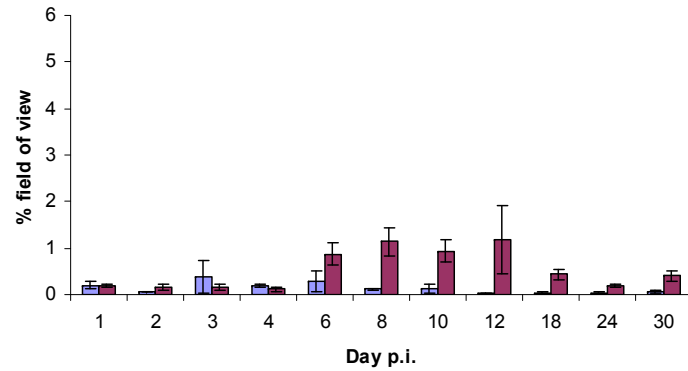
Liver: day 8

Chicken
Turkey

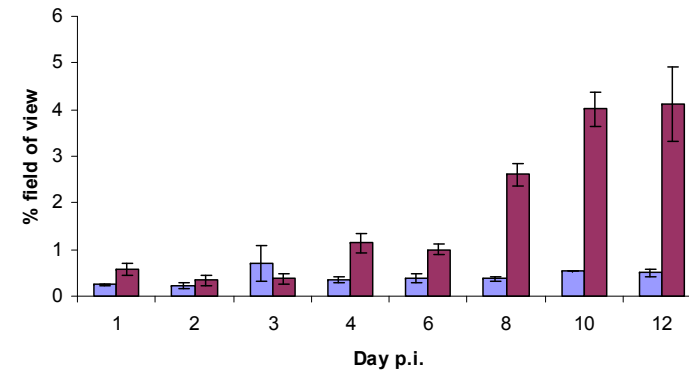


Immunohistochemistry: CD4+ cells

Chicken
Liver

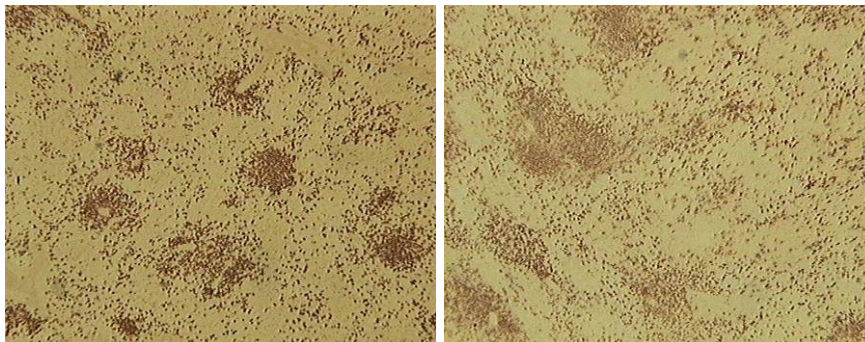


Turkey
Liver



■ = control
■ = infected

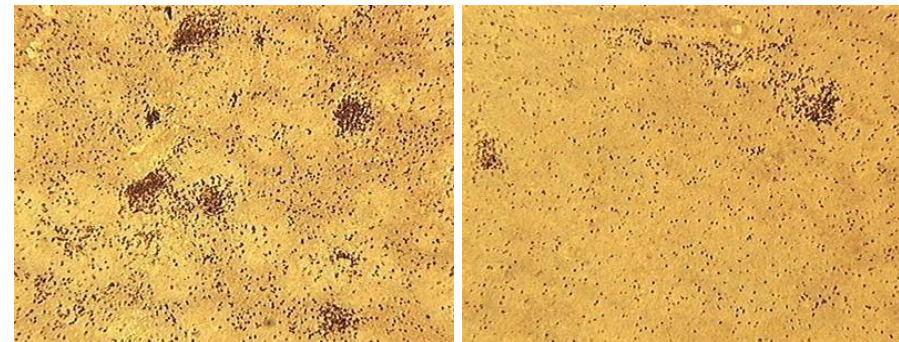
Spleen



Control

Day 10 p.i.

Spleen

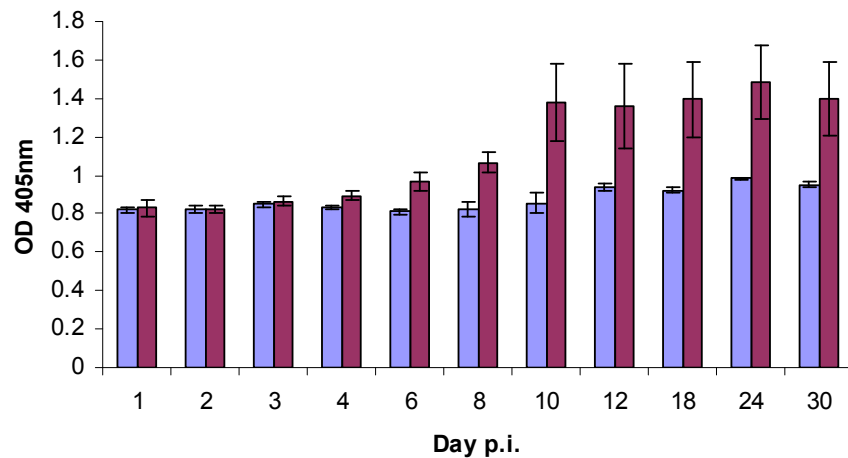


Control

Day 10 p.i.

Antibody response

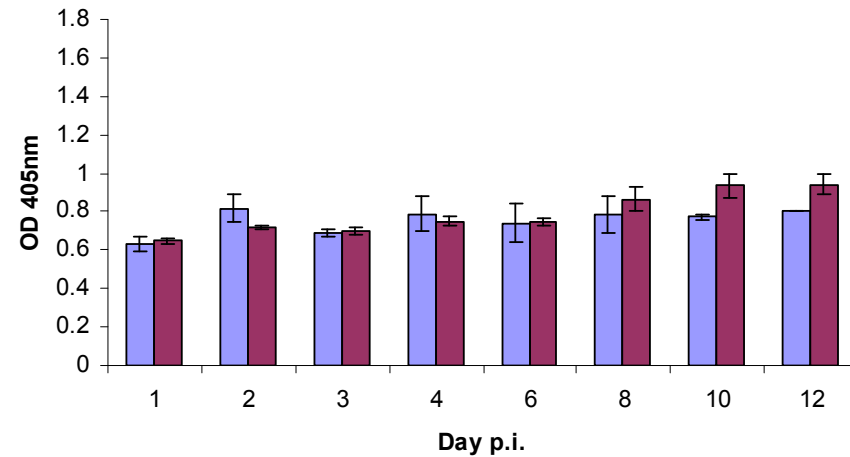
Chicken



Raised antibody in chicken sera
from day 6 p.i.

Turkey

■ = control
■ = infected



Less evident increase in antibody
from turkey sera

Conclusions

□ Chicken

- Early effective innate response
- Limits protozoan movements to the liver
- Adaptive response controls pathology in caeca and liver
- Limited cellular influx
- Antibody response
- Protozoa confined to caecal lumen



Asymptomatic carrier

□ Turkey

- Lack of innate caecal response
- Protozoa move to liver in greater numbers
- Caecal pathology does not recover
- Excessive cytokine and cellular response in liver
- Less evident antibody response
- Immunopathology



High Mortality Rates

Innate differences: genetic based?

- ❑ Could the innate response of the turkey be compromised as a result of genomic differences?
 - ❑ Pathogen recognition?
 - ❑ Signalling pathways?
 - ❑ Cytokines show high identity between the chicken and turkey but several differences do exist
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Acknowledgements

- IAH, Compton
 - **Avian Genomics**
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