



A Comparison of the Gut Microbiota in Indoor and Outdoor Reared Pigs

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Introduction



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- Outdoor rearing is gaining in popularity
- What effect does this have on the gut microflora?
- Are outdoor-reared pigs more susceptible to zoonotic infections?
- This study -
 - Effect of environment on microflora
 - Incidence of zoonoses



Bacterial Zoonoses

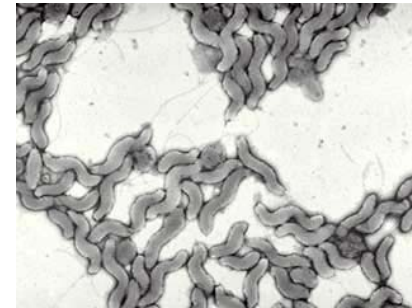


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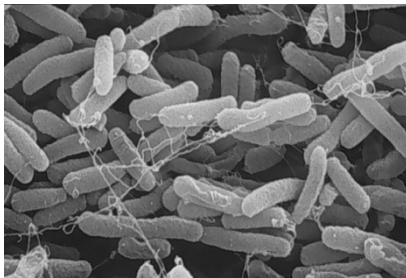
Salmonella spp.

S. Typhimurium accounts for 70% of salmonella isolates from pigs



Campylobacter spp.

The most common cause of bacterial gastroenteritis in humans in the UK



Verocytotoxigenic *Escherichia coli* O157

It causes post-weaning diarrhoea and oedema disease



Clostridium difficile

This is the most common cause of neonatal enteritis in swine in the USA

Experimental Design



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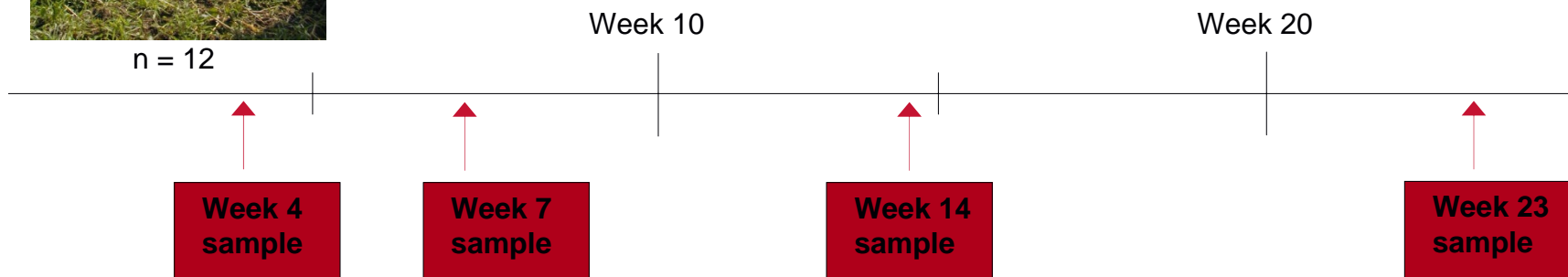
n = 12



n = 12

Weaned at 4 weeks

Slaughtered at 25-27 weeks



Analysis of Samples



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Microbiological methods

Commensals

Salmonella spp.



Molecular methods

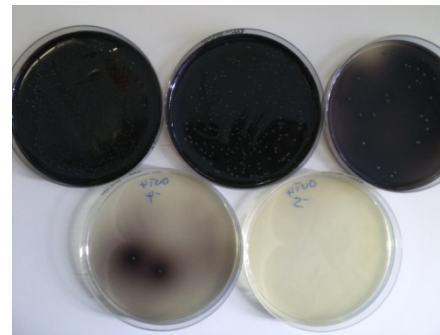
C. difficile

C. jejuni

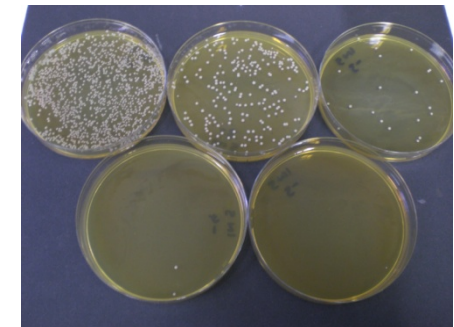
VTEC O157

Microbiological Isolation

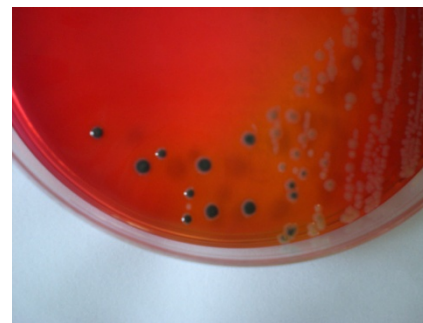
- General bacteria present
 - Enterococci
 - Lactobacilli
 - *Bacteroides* spp.
 - Coliforms
- *Salmonella* spp.



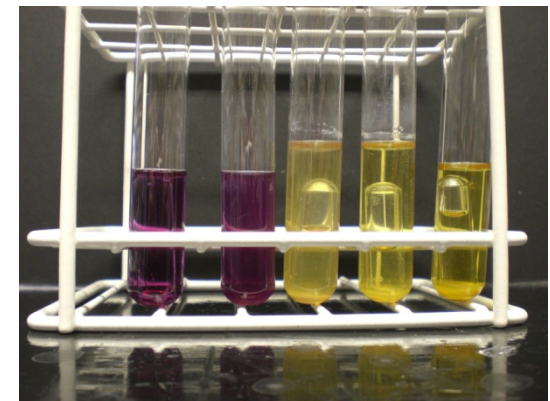
enterococci dilution series
on KAA



lactobacilli dilution series
on LAMVAB



S. Typhimurium growing on
XLD



MPN coliform count

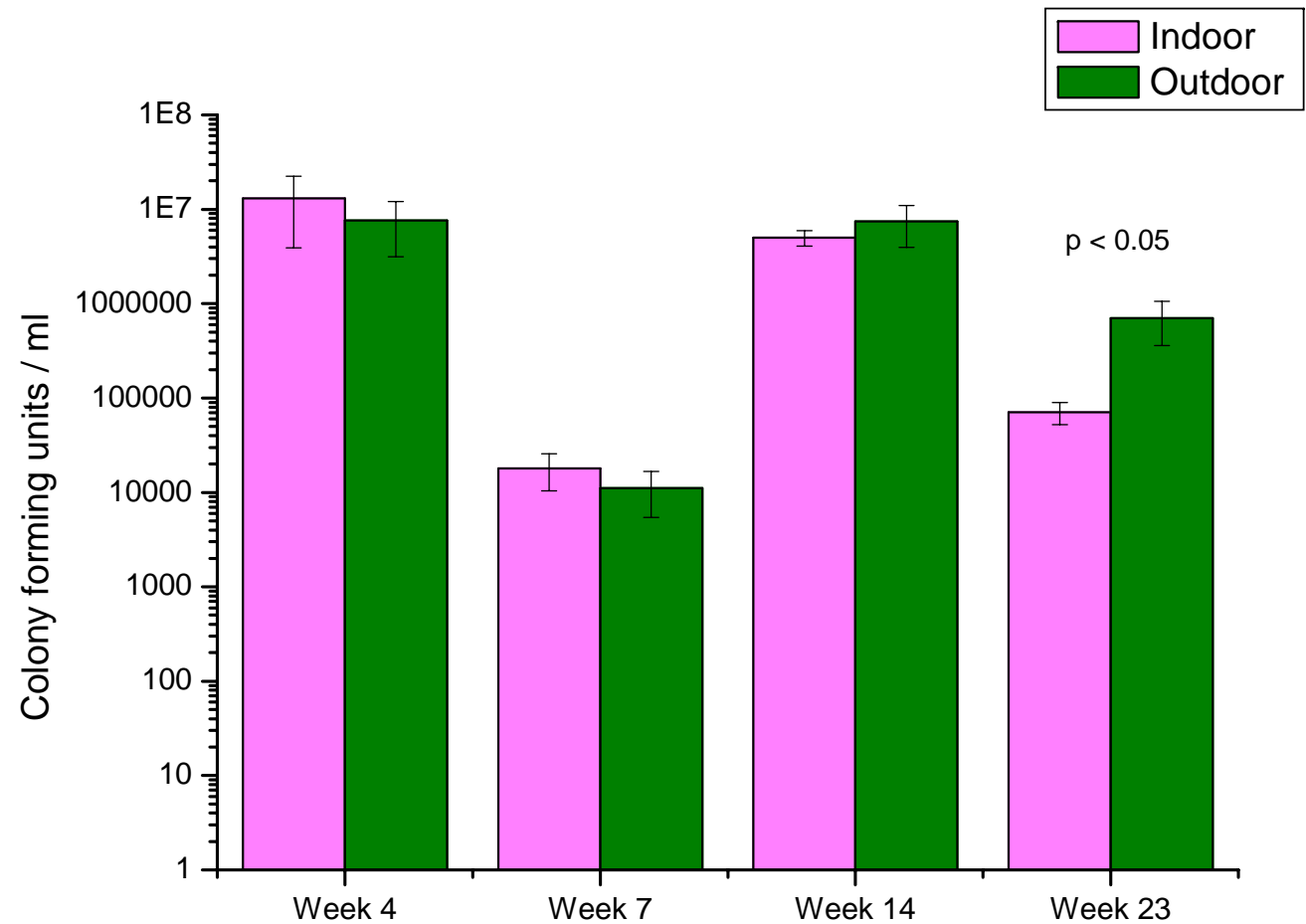
Microbiological Analysis



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Enterococci counts

Weeks	In	Out
4 vs 7	P<0.001	P<0.05
7 vs 14	P<0.001	P<0.001
14 vs 23	P<0.001	P<0.001



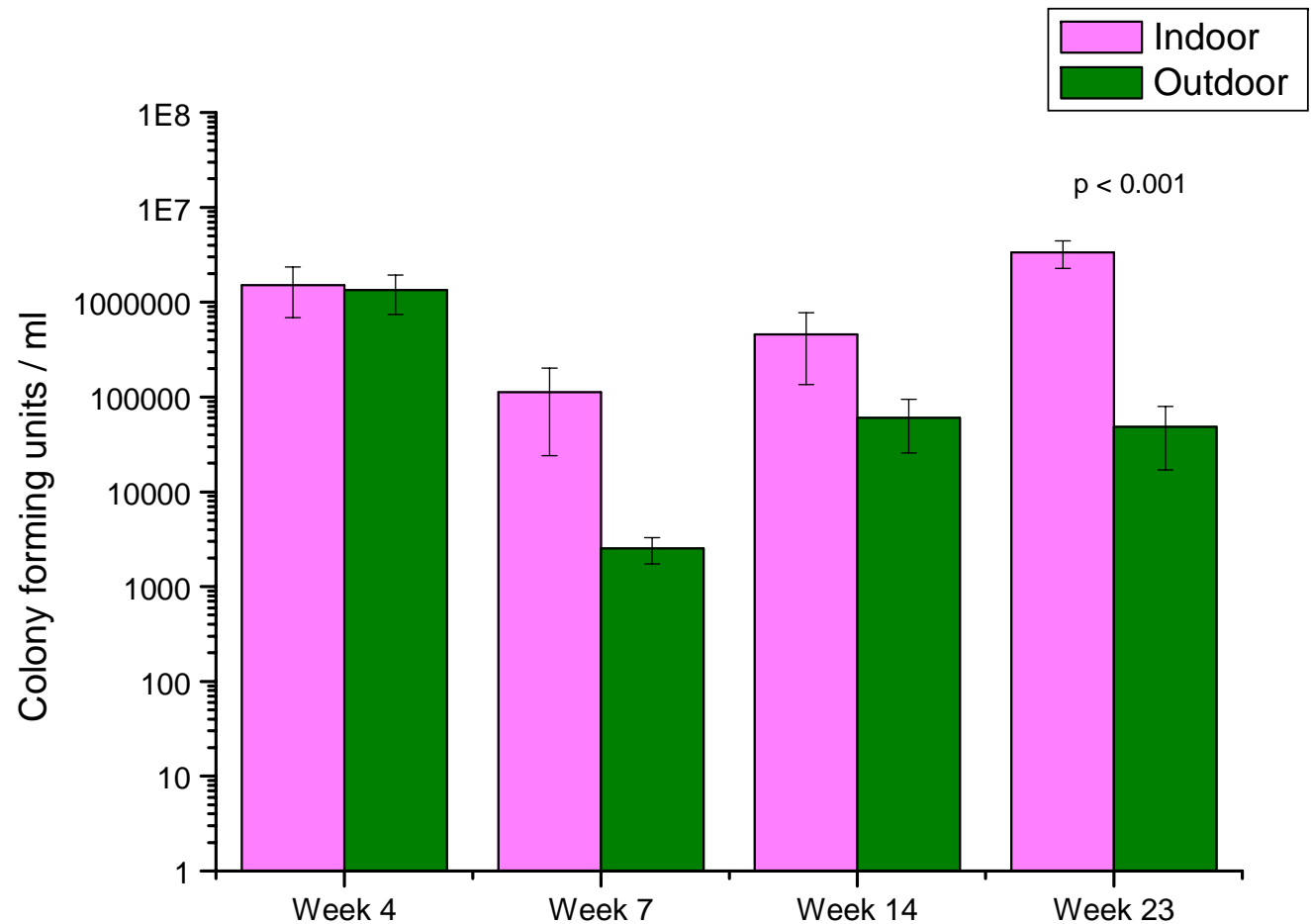
Microbiological Analysis



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Lactobacilli counts

Weeks	In	Out
4 vs 7	P<0.01	P<0.001
7 vs 14	NS	P<0.001
14 vs 23	P<0.001	NS



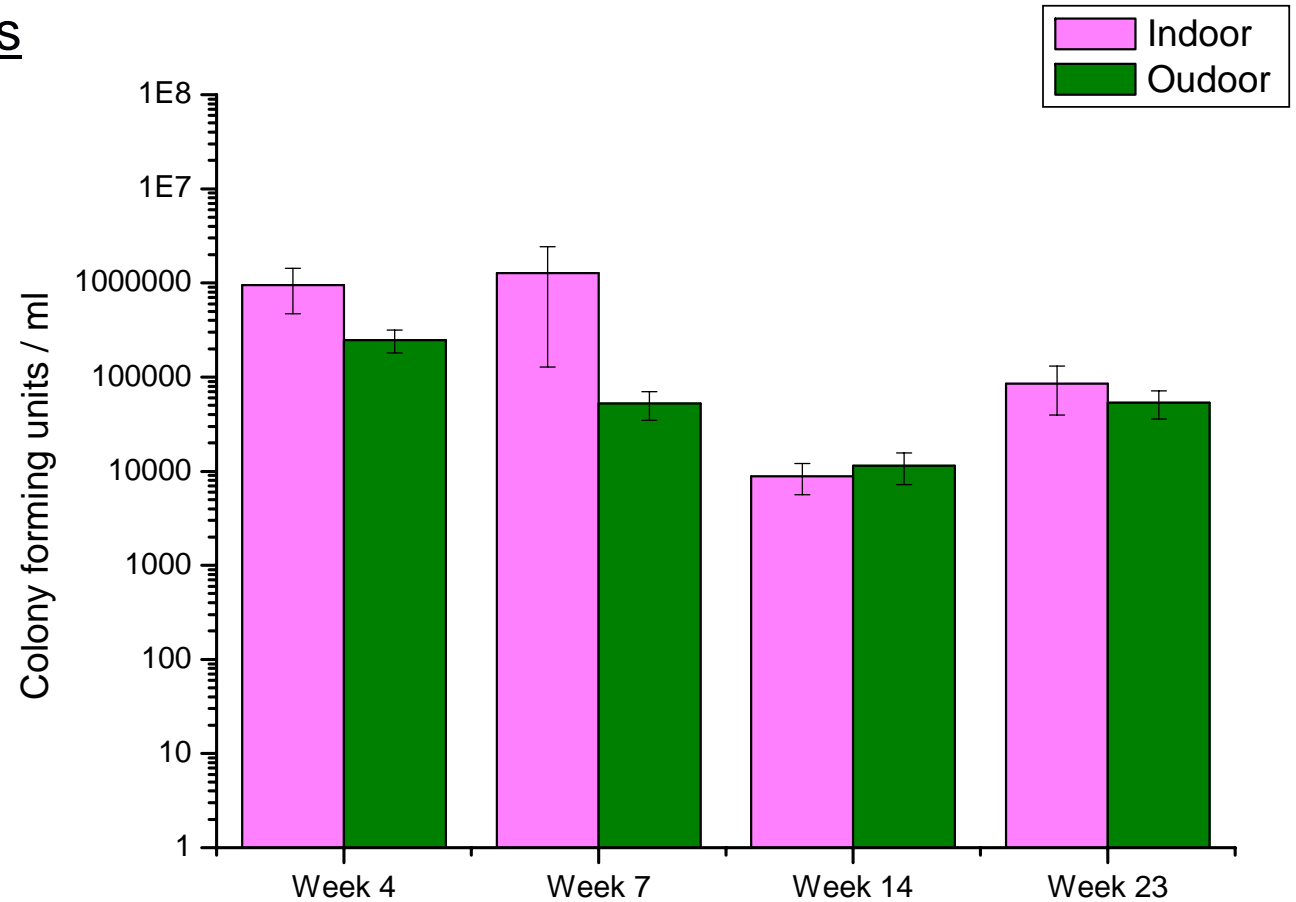
Microbiological Analysis



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Bacteroides spp. counts

Weeks	In	Out
4 vs 7	P<0.05	P<0.01
7 vs 14	NS	NS
14 vs 23	P<0.05	NS



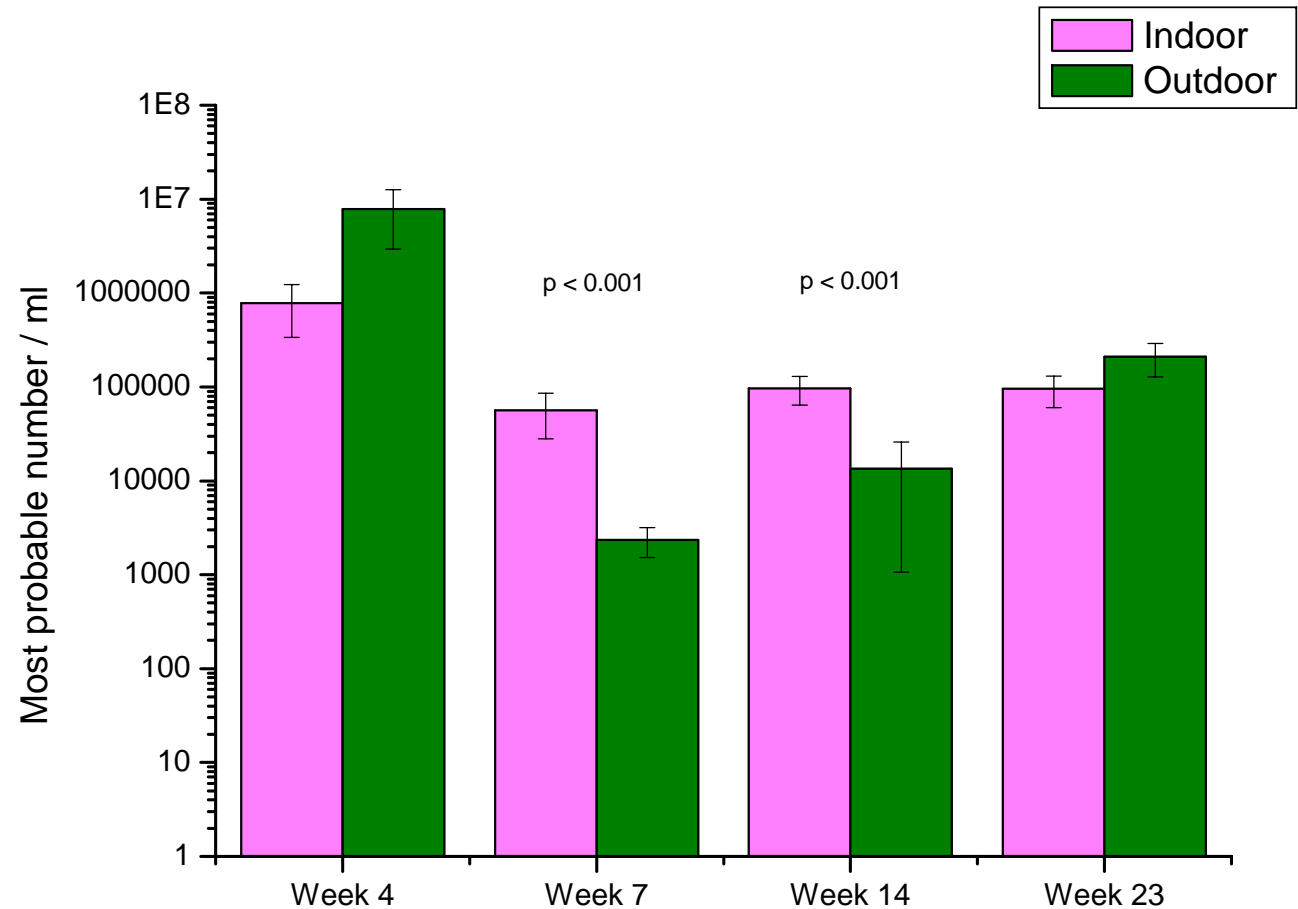
Microbiological Analysis



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Coliform counts

Weeks	In	Out
4 vs 7	P<0.001	P<0.001
7 vs 14	NS	NS
14 vs 23	NS	P<0.001



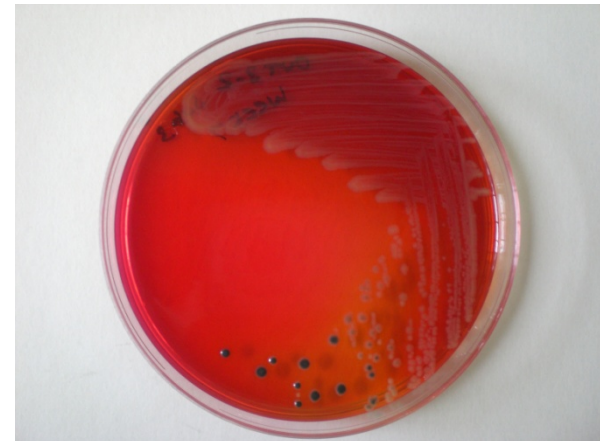
Microbiological Analysis



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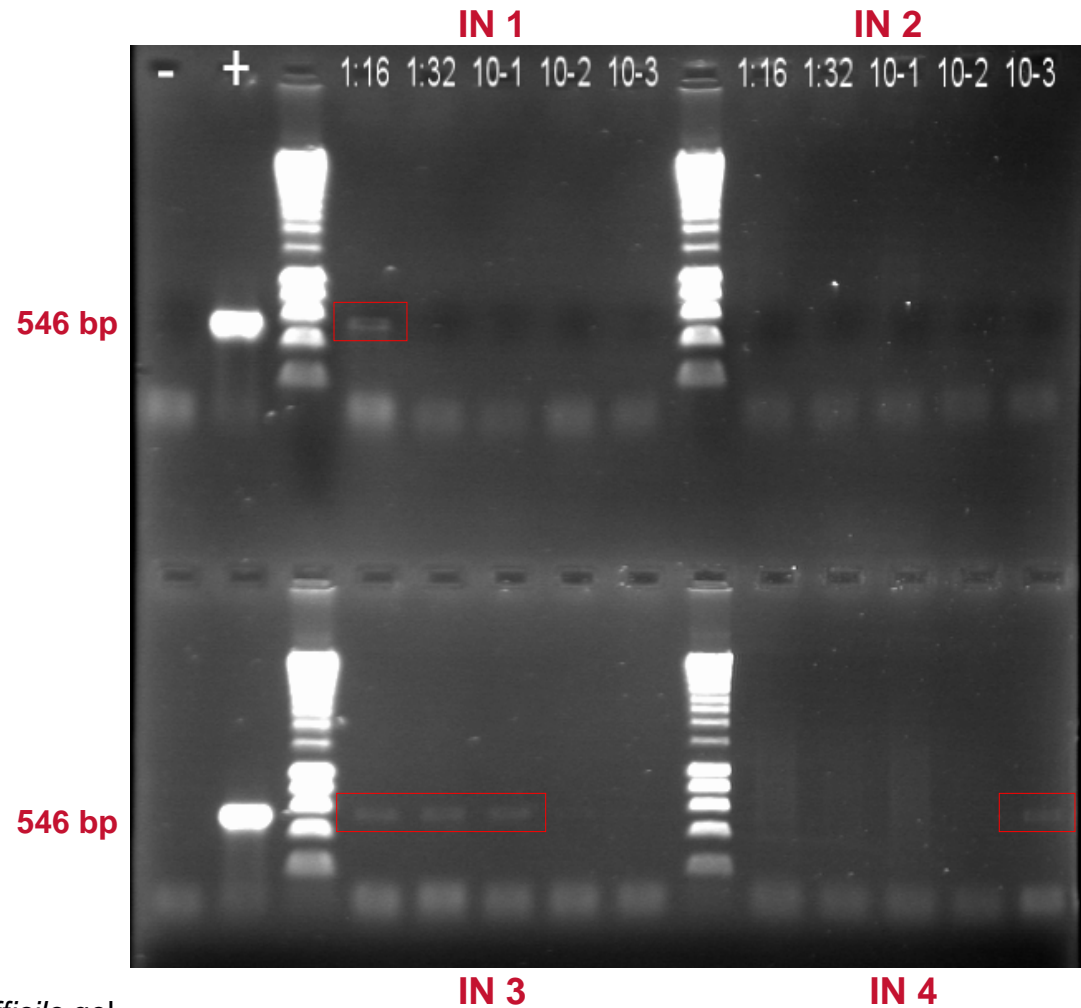
Salmonella isolation

Week	Indoor	Outdoor
4	1	0
7	1	2
14	0	0
23	0	0



- **PCR to detect zoonotic pathogens**

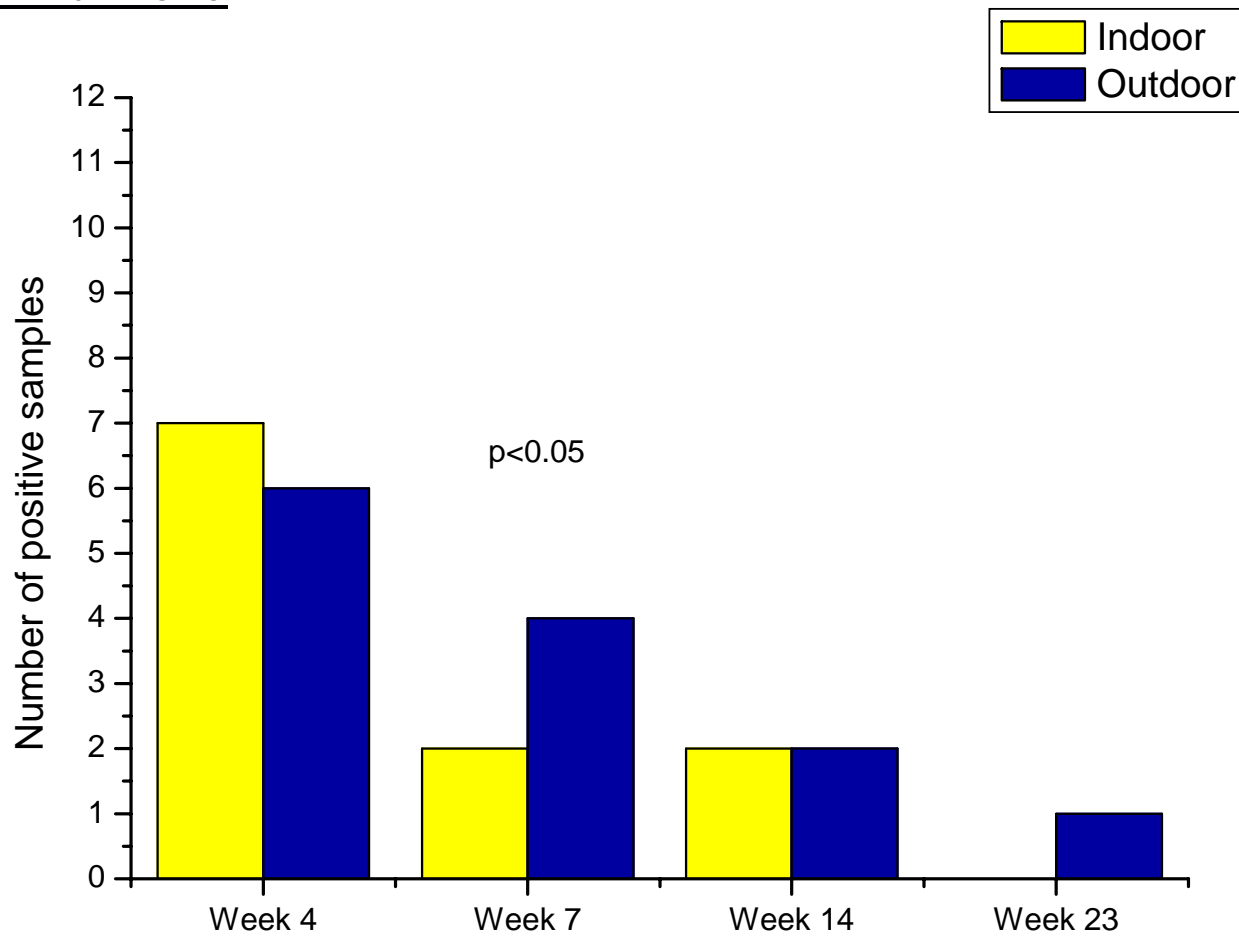
- Toxin A gene for *Clostridium difficile*
- *HipO* gene for *Campylobacter jejuni*
- *eaeA* gene for VTEC O157:H7



Example of a *C. difficile* gel

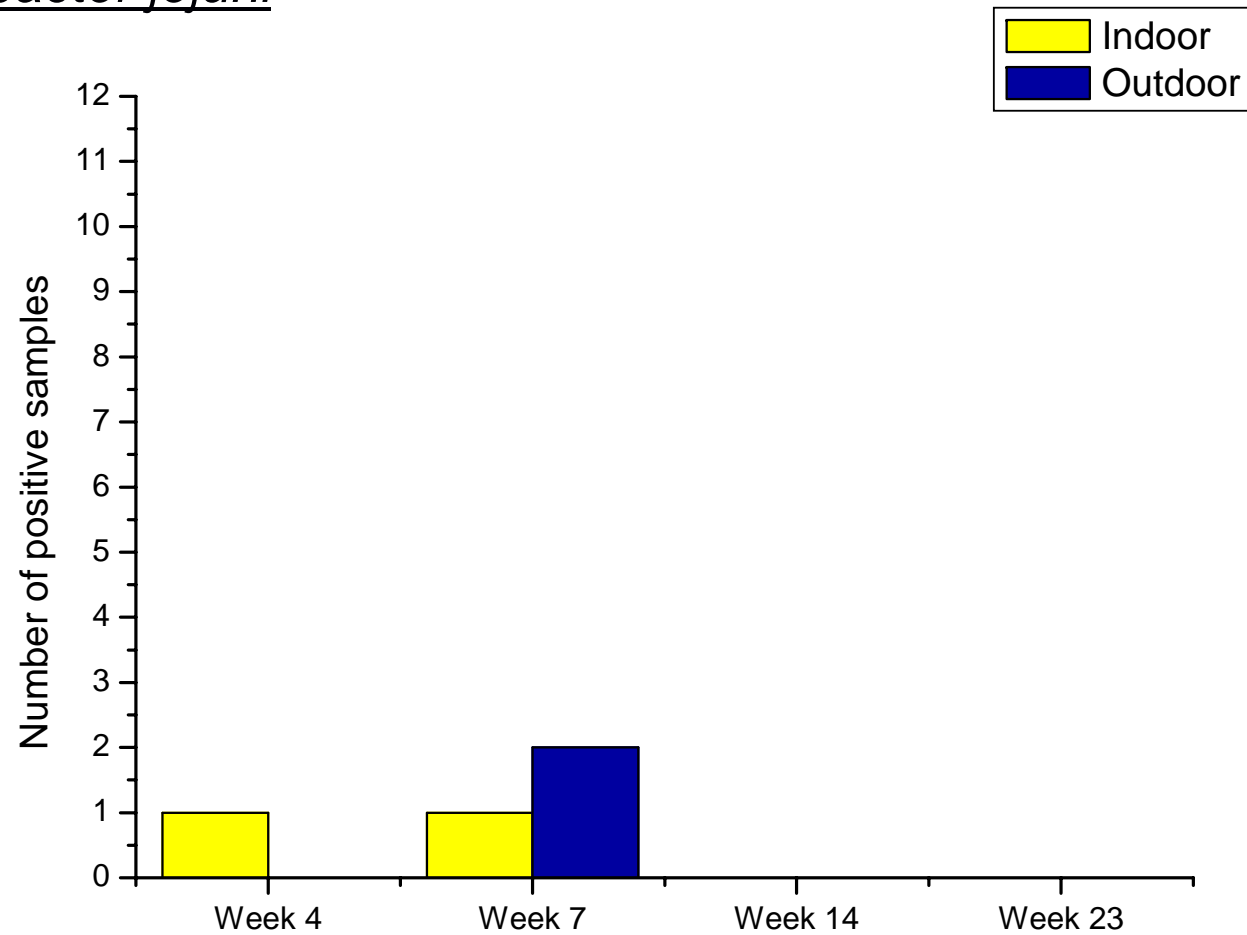


Clostridium difficile





Campylobacter jejuni

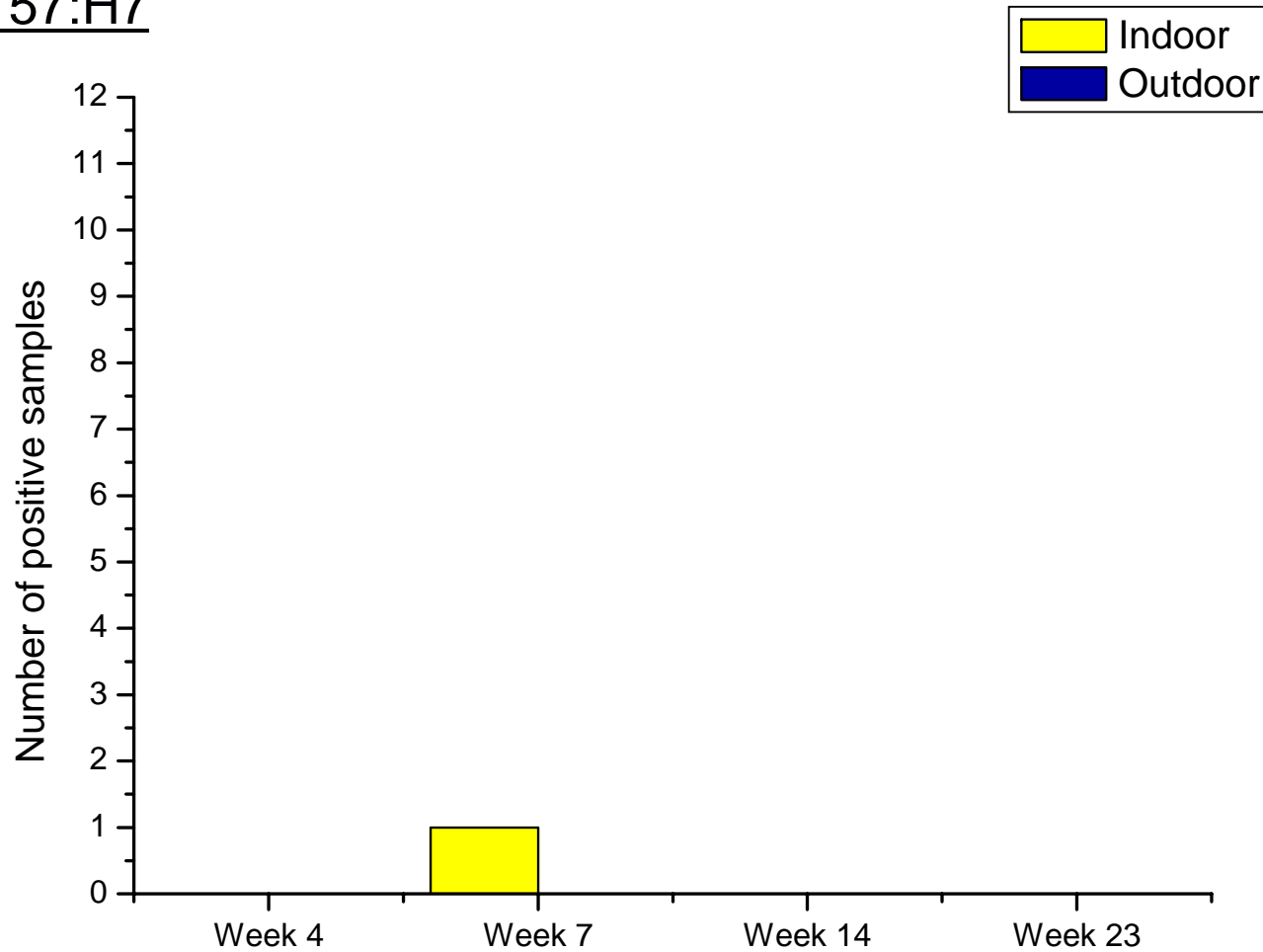


Molecular Analysis



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VTEC O157:H7



Summary of Findings



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- Environment may affect microflora but other factors are important
- Indoor pigs retain lactobacilli better than outdoor pigs
- Asymptomatic *C. difficile* colonisation appears common in piglets



Acknowledgements



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- Jerry Knapp & Helen Miller
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- Sue Bickerdike
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