Molecular epidemiological studies of *Campylobacter* isolated from different sources in New Zealand between 2005 and 2015

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Abstract

Campylobacteriosis is one of the most important food-borne diseases worldwide, and a significant health burden in New Zealand. *C. jejuni* is the predominant species worldwide, accounting for approximately 90% of human cases, followed by *C. coli*.

The first study evaluated whether the time elapsing from sampling to culture has an impact on the recovery rate of *Campylobacter*, and explored whether some sequence types are more likely than others to be missed due to delayed culture. The study revealed that, whereas delayed culture may affect the recovery rate of *Campylobacter*, there was no evidence of a bias due to specific sequence types being under detected.

The second study aimed to analyse the differences in the *Campylobacter* viable counts and in population genetic structure between chicken drumsticks and whole carcass meat for retail sale. The results indicate that the *Campylobacter* population genetic structure did not differ between the two types of retail chicken meat. However, the difference in *Campylobacter* viable counts suggest that consumption of different chicken meat products may pose different risks of campylobacteriosis associated with an exposure to different infection doses.

In the third study, we genotyped *C. coli* isolates collected from different sources between 2005 and 2014, to study their population structure and estimate the contribution of each source to the burden of human *C. coli* disease. Modelling indicated ruminants and poultry as the main sources of *C. coli* infection.

The fourth study aimed to genotype *C. jejuni* isolates collected between 2005 and 2015 from different sources, to assess changes in the molecular epidemiology of *C. jejuni* following the food safety interventions implemented by the New Zealand poultry industry in 2007/2008. Modelling indicated that chicken meat from 'Supplier A' was

the main source of *C. jejuni* human infection before the interventions; but after the interventions, ruminants became the main source of infection, followed by chicken meat from Supplier A.

This thesis has made us aware of the aetiology of *C. coli* infections and the change in the attribution of *C. jejuni* infections. These findings should be used in developing further strategies to reduce the total burden of human campylobacteriosis.

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List of presentation and publication

- Molecular epidemiology of *Campylobacter coli* isolated from different sources in New Zealand between 2005 and 2014. Poster presented at the 18th International Workshop of *Campylobacter*, *Helicobacter* & Related Organisms (CHRO), Rotorua, New Zealand, 1-5 November 2015.

- **Nohra A, Grinberg A, Midwinter AC, Marshall JC, Collins-Emerson JM, French NP.** 2016. Molecular epidemiology of *Campylobacter coli* isolated from different sources in New Zealand between 2005 and 2014. *Applied and Environmental Microbiology* 82: 4363-4370.

Nomenclature

BA	Blood agar
BB	Bolton Broth
BPW	Buffered peptone water
CC	Clonal complex
cfu	colony forming unit
CrI	Credible interval
DALY	Disability Adjusted Life Years
DNA	Deoxyribonucleic acid
ELISA	Enzyme-linked immunosorbent assay
ESR	Environmental Science and Research Ltd.
GBS	Guillain-Barré syndrome
HL	Heat-labile
HS	Heat-stable
IID	Infectious intestinal disease
IVABS	Institute of Veterinary, Animal and Biomedical Sciences
mCCDA	modified Cefoperazone Charcoal Deoxycholate agar
MCL	Maximum composite likelihood
^{m}EpiLab	Molecular Epidemiology and Public Health laboratory
ML	Maximum likelihood
MLST	Multi locus sequence typing
MU	Massey University
NMDS	Non-metric multidimensional scaling
PCR	Polymerase chain reaction

PERMANOVA	Permutational multivariate analysis of variance
PFGE	Pulsed field gel electrophoresis
PSI	Proportional similarity index
spp.	Species
ST	Sequence type
WHO	World Health Organisation

Thesis structure and format

This thesis is composed of six chapters covering a literature review, four research-based chapters and a final discussion. Raw data are presented in Appendices. Some repetition between chapters was inevitable due to the style of the thesis presentation, especially in the materials and methods sections. These repetitions allow each chapter to be read in isolation.

Chapter one

This chapter is a general overview covering the main concepts and overviewing the influential literature addressed in the thesis. It discusses the molecular epidemiological studies of human campylobacteriosis in New Zealand and other countries and summarises the studies done in this PhD projects.

Chapter two

This chapter compares direct versus delayed culture for *Campylobacter* in human faeces, titled: **"Detection and recovery rate of *Campylobacter* from faecal swabs: Direct vs delayed culture"**

Chapter three

This chapter compares two types of chicken retail meat (whole carcasses versus drumsticks) collected from different suppliers, titled: **"Abundance and multilocus genotypes of *Campylobacter* species isolated from chicken drumsticks and whole carcasses obtained from different suppliers in the retail chain".**

Chapter four

This chapter titled **"Molecular epidemiology of *Campylobacter coli* isolated from different sources in New Zealand between 2005 and 2014"** formed the basis of a paper published in Applied and Environmental Microbiology:

Nohra A, Grinberg A, Midwinter AC, Marshall JC, Collins-Emerson JM, French NP. 2016. Molecular epidemiology of *Campylobacter coli* isolated from different sources in New Zealand between 2005 and 2014. Applied and Environmental Microbiology 82: 4363-4370

Chapter five

This chapter compares the source attribution of *C. jejuni*-associated campylobacteriosis cases before versus after intervention, titled: **"Changes in the molecular epidemiology of *Campylobacter jejuni* following food safety interventions by the poultry industry".**

Chapter six

This chapter summarises and discusses the significance of the results of the previous studies.

Appendices: The raw data and supplementary materials of each chapter are presented in this study.

Bibliography: The literature cited is presented in the format required by Applied and Environmental Microbiology journal.

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