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Epidemiology and Control of Leptospirosis in Farmed Deer in New Zealand.

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy in Veterinary Clinical Science

At Massey University, Palmerston North, New Zealand.

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2006
Abstract

Leptospirosis has been reported in farmed deer in New Zealand since 1980 but knowledge was limited. Studies presented in this thesis investigated the epidemiology and distribution of infection associated with serovars Hardjo bovis, Pomona, and Copenhageni in farmed deer, efficacy of a vaccine and the influence of maternally derived antibody, and aspects of exposure of humans to leptospirosis. Serology, bacteriology, and pathology were employed as determinants of infection and vaccine efficacy.

A serological survey of 2016 deer from 110 herds confirmed leptospirosis throughout New Zealand with 61.3% of herds infected with Hardjo bovis and 3.6% with Pomona alone, 16.4% with dual infections with those serovars, and none with Copenhageni, giving an overall herd prevalence of 81.3%.

Epidemiological studies involved serological analysis of samples from a serum bank involving weaner, yearling and adult deer (n=10/group) from 15 farms sampled 3-monthly for 21 months, and intensive blood and urine sampling of young deer on three farms over 1-2 production cycles (n=15-65/group). Infection with Hardjo bovis followed an age-related endemic cycle with some animals infected by 3-4 months of age and seroconversion peaking at up to 57% at12-15 months and mild kidney lesions typical of a host-adapted organism. Infection with Pomona followed an epidemic pattern with seroprevalence of up to 100%, more severe kidney lesions, clinical signs and evidence of reduced growth and reproduction, typical of an accidental host relationship. Leptospira were observed in 30.4% of urine samples and 37.0% of kidneys.

Vaccination with “Leptavoid 3” (Schering-Plough Animal Health Ltd) was studied on one non-infected, one Hardjo bovis infected, and two dual Hardjo bovis/Pomona infected herds. Vaccination produced sustained titres in uninfected young and adult deer, and no maternally derived antibody interference was observed in progeny vaccinated at approximately 3-4 months of age. In infected herds, vaccination enhanced seroprevalence and antibody titres, and reduced urine shedding by 44% and culture from urine and kidneys by 37% in the face of continued natural challenge.

Analysis of previous data combined with pooled data from the above studies, indicated that 73.0% of lines and 29.0% of individual deer at slaughterhouses had kidney lesions indicative of leptospirosis with a relative risk (RR) of 1.08 and 1.6 for the relationship between seropositivity to Hardjo bovis and Pomona, respectively. The overall RR between positive serology, lesion and culture was 2.1. The kidney culture rate ranged from 2.5-33% between herds demonstrating significant risk of exposure to humans, particularly slaughterhouse workers.

This study has provided an understanding of the epidemiology in farmed deer and control options available to the industry.
Acknowledgements

A number of people, family, friends, colleagues, and organizations from México and New Zealand (NZ) have contributed immensely towards the achievement of this study and my time in NZ (Aotearoa, the land of the long white cloud!!). I have a strong belief in the importance of being able to say thank you, and recognising others in your life, in both your personal or professional accomplishments. In the Latin-Amer can culture and particularly in my “México del alma (of my soul)” it is important to know how to say thank you! (¡Gracias!). I know that this list is long, but I value and treasure all the support and contributions, which made this study possible, and what it represents to me personally.

Professional Acknowledgement:

To my great group of supervisors and friends: Dr. Julie Collins-Emerson, Dr. Anne Midwinter, Prof. Peter Wilson, Dr. Cord Heuer (Danke!) and Dr. Colin Mackintosh; who have guided me through this research with knowledge, patience and experience, thank you. Thank-you for your support, learning opportunities, wonderful “can do” attitude whenever we faced challenges in the process of the research and surviving my dyslexia!!!

I am deeply thankful to my academic sponsor CONACyT (National Council of Science of Technology) Government of México for my scholarship funding, UNAM, FES-C (México National Autonomous University, Cuautitlán Superior Studies Faculty), and the research sponsors, DEEResearch (Deer Industry New Zealand), and Schering-Plough Animal Health Limited. To México and NZ as countries for all the opportunities they represent and the beauty in them.

The New Zealand Deer Farmers: without you there would have been no research project. I would like to particularly thank Mr. Tim Aitkens and family (my No. 1 Farmers, and great friends), Mr. Owen Cowie and Mr. Lockie Tylee for their interest, sponsorship, knowledge, hard work, trust and access to their deer herds. I would also like to acknowledge the 100 plus farms involved in this study, Massey University’s Deer Research Unit, the Deer Slaughter Premises (Hastings, Fielding and Hokitika), and Dr. L. J. M. Audige and his PhD project (1995), that provided serum samples and data that were one of the corner stones of this project.

My gratitude and thanks also goes out to the many veterinarians involved in this study. Their time, interest, ideas, experience, disposition and help to the project and to me personally is deeply appreciated; DMV. MSc. Arturo Luque, Dr. Alex Grinberg, BVSc. Nick Wheelan, Dr. Simone Magnino, BVSc. Ian Walker, BVSc. Glenn Dean, BVSc. Adrian Campbell, BVSc. Alison Quinn, and Mr. Tony Pearse from DINZ;.

Thanks also needs to be given to those who gave technical support and assistance with sample collection, key to making the research real, to my friends and colleagues; Geoff Purchas (thank you for time, knowledge and wonderful disposition!), Fernanda Castillo Alcala*, Natasha Swainson.*, Jaime Glossop.* (*“Dear-Deer-Ladies”!!), my dear “amigo” Martin Chesterfield, and Geoff Warren. To all the Dutch, French, and Kiwi students: Anne-Hélène Bunod, Ross Moolenar, Florochet, Mirka, Marleen, Andrew and Daniel, and to all the Latin American friends that have marched through the “Deer farm experience” with me.
Dedicatory:

I would like to dedicate the effort and personal growth that going through the PhD represents. To my family (Ma, Pa, Pau, Luis, Sonia and Natalia), I simply would not be me, without you or without what you have taught me.

I also want to dedicate all that this research represents, to six extraordinary friends that through their courage have taught me and reinforce in me, how brave the fight for life is, how important and grand life is, and to live life fully, honestly, with faith and with an open heart. This dedicatory is small and humble in front of your courageous battles. To my dear friends; Arturo Luque (Usted es gente grande, en todos sentidos y en cualquier lugar caballero) and Family, Javi Cañumir Contreras (Corazón más valiente no he conocido, mi niña querida), Dr. Armando Shimada Miyasaka (No hay palabras para describir la fuerza de su espíritu), Mrs. Shirley Tejeda (Noble corazón en todo momento), my “Dear-Deer” Peter Wilson and Sylvia Weil.

Personal Acknowledgement:

To those in my family that are as close as friends and the friends that are as close as family you have made such a difference in my life; the Families Esquivel-Ayanegui, Alcérreca-Martínez, Ulloa-Escobedo, and Loubet-García, Lili-Daniel & Fam., Angélica-Manuel & Fam., Francisco & Fam., mi siempre querido Dr. Jorge & Fam., Horacio & Fam., Ale V. & Fam., Fernanda C. & Nacho L., Natalia B., Victor R., Kielia S., Suemi R., Fam. Luque-Flavel, Vicky-Alex Grinberg & Fam., Fam. Jiménez, Fam. Zegbe, Fam. Cañumir-Contreras and Fam. Laca Gastaldi.

To all the great friends that NZ has given me and who have made such a difference in my time here. You have given me so much and you will be part of my heart forever; Fam. Hepp (Ch.), Lisa (Guat.), Alfredo (Mx.), David (Pr.), Florencia (Uru.), Fabio (Brs.), Alexis (Uru.) Federico (Uru-Arg-Sue!!!), Elly (Uru.), Viviana and Alejandro (Mex.), Muddy (EUA), Susan (NZ), Natasha (NZ), Jaimie (Au.), Barbara (Au.), Leanna (Au.), John and Paulina (NZ.), and Nick Wheelan & Fam (NZ). To my mentors and friends, who undertook the challenge of helping, guiding and supporting my professional development: mi maestro Dr. Jorge Tórtoora Pérez, Dr. Guillermo Valdivia Anda, MVZ. René Guzmán Ramírez

To those at Massey University IVABS, The Deer Research Group and the Epicentre that made this time a special and enjoyable one; Prof. Colin Holmes, Prof. Tom Barry, Dr. Nicolás López Villalobos, Mr. Peter Wildbore, Mr. Mike Hogan, Mr. Hamish Mack, Mrs. Allain Scott, Dr. Simone Hoskins, Prof. Peter Davies & Fam. To all the lovely deer and the Deer Industry of NZ, you never cease to amaze me. Deer are magnificent creatures and every encounter with them is a new learning opportunity. It has all been worth it, even with the kicks, bruises and some close encounters of the not so nice kind!, Its been an amazing journey with a very special challenge.

¡Gracias! (Thank you!) to all of you, for the support, the belief, the tolerance, the friendship, and the love during this project and during my whole life for some of you. I know, I have had my hard and dramatic moments, even so, all of you have stood by me. I love you people.
Preface

Leptospirosis is a contagious and infectious spirochaete bacterial disease caused by various serovars of the genus *Leptospira* (OIE 2000). Leptospirotal infections are an emerging health problem in human and veterinary medicine, having an important economic impact on production animal industries, and being one of the most frequent zoonoses in the human population (Plank and Dean 2000; Levet 2001).

There is limited information about leptospirosis in deer (Prescott 1993). Evidence from surveys of free-ranging and farmed deer from 1957 to 2005 indicates that *Leptospira* have been prevalent in many deer populations internationally (Ayanegui-Alcérreca et al. 2003). Nineteen serovars have been reported in deer, but only serovars Hardjobovis, Pomona, Copenhageni, and Roumanica have been isolated (Ayanegui-Alcérreca et al. 2004).

Leptospirosis in farmed deer in New Zealand has been reported intermittently for about 25 years (Ayanegui-Alcérreca et al. 2003). Nevertheless, not much was known of its prevalence, epidemiology, subclinical effects, prevention, and human health significance (Wilson et al. 1998). Bacterial cultures and serological results from New Zealand suggest that serovars Hardjobovis and Pomona are the most frequent pathogens in red deer (*Cervus elaphus*) and Copenhageni has been linked to occasional outbreaks (Flint et al. 1986; Griffin 1987; Ayanegui-Alcérreca et al. 2003).

The research presented in this thesis was in response to the Deer Industry’s desire for robust data on the national distribution and on-farm epidemiology of leptospirotal infections, as well as the effectiveness of vaccination in reducing risk to animals and humans. Data will provide guidance for the deer industry in determining the need for an industry-wide control strategy, and if so, the most appropriate course(s) of action.

Thesis format

- Chapter 1 contains an extensive literature review of the biology of leptospirosis and its role in farm animal disease in general, but with a particular reference to deer. This Chapter contains review papers entitled: “Leptospirosis in New Zealand farmed deer: A review” and “A review of international reports of leptospirosis in deer” which have been submitted to scientific journals for publication.
- Chapter 2 describes methodology common to the research presented in Chapters 3 to 8.
- Chapters 3 to 8 describe individual research projects written largely in the format for papers to be submitted to scientific journals. The methodology specific to each chapter is described in them.
- Chapter 9 is a general discussion, which brings the research into context, to allow a broad presentation of the relevant results of the different research projects.
- Appendices 1 to 4 contain the raw data for Chapters 3 to 8.
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Presentations


* = Speaker