Bovine mastitis in New Zealand

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Abstract

This thesis represents an aggregation of knowledge on bovine mastitis in the New Zealand dairy industry. Firstly, the thesis reviews the factors influencing the economic impact of bovine mastitis. Secondly, it provides information on the incidence of clinical and subclinical mastitis, as a prerequisite for estimating these costs. Thirdly, it investigates the effects of experimentally-induced *Streptococcus uberis* mastitis early in the dry period on milk production in the subsequent lactation.

In the review of factors influencing the cost of bovine mastitis, it was clear that neither farmers nor farm advisors have a good understanding of its full economic impact. In order to better understand these costs, it is necessary to have a clear idea of the incidence and consequences of clinical and subclinical mastitis: areas of knowledge which were identified as being deficient. Hence, two studies were conducted to investigate these areas.

In the first study, the incidence of clinical mastitis in Northland, New Zealand, was estimated. Furthermore, the aetiological agents causing mastitis were elicited and their chronological distributions in lactation were described. The average incidence of clinical mastitis was 0.19 cases per 305 cow-days at-risk, which is higher than previously reported in New Zealand. There were approximately equal numbers of isolations of *Staphylococcus aureus* (23.7%), and *Strep. uberis* (23.3%) from clinical cases: a pattern that is remarkably different to elsewhere in the country. Clinical mastitis due to *S. aureus* or *Strep. uberis* differed between age groups, with the highest incidence of *S. aureus* isolations from older cows (0.043 cases per 305 cow-days-at-risk) and lowest from 2-year old cows (0.014). The incidence of *Strep. uberis* was similar in first calving (0.034 cases per 305 cow-days-at-risk) and older cows (5 year-old: 0.039 cases, 6 year-old: 0.030 cases). Overall, 12% of cows were temporarily removed from supply and 1% were culled for mastitis. The differences between the study in Northland and these reported elsewhere from NZ highlight the need for a national survey on the aetiology and epidemiology of bovine mastitis.

A second study evaluated the effects of *Strep. uberis* clinical mastitis in the early dry period on milk production in the subsequent lactation. In a previous study,

Strep. uberis mastitis was experimentally induced and then promptly treated. This experiment provided a data set from which the impact of *Strep. uberis* clinical mastitis early in the dry period on milk production in the subsequent lactation could be estimated. Results of this study indicated that an early dry period clinical mastitis due to *Strep. uberis,* when promptly treated, did not affect production in the subsequent lactation. For cows that suffered mastitis episode during early dry period compared to those that did not, there was no difference in milk yield (5126 vs. 5010 litres), fat yield (267 vs. 264 kg), and protein yield (182 vs. 179 kg), respectively. It was considered that the short duration of intramammary infection did not cause permanent damage to the mammary secretory tissue.

It was concluded that the current estimates of the economics of mastitis in New Zealand are probably under-estimating the real cost of mastitis to its dairy industry. This was based on the higher incidence of clinical mastitis in Northland than elsewhere in the country and a failure of previous studies to take into consideration the costs associated with animals that were temporarily removed from supply (i.e. rather than culled). Additionally, as the highest frequency of new intramammary infections occurs in the first week or two after drying off, it may prove beneficial for farmers to pay more attention to checking for clinical mastitis during the early dry period.

Preface

It is more than 3 years ago that I started designing a project for my Masters degree. At that time I was working for Dr Ross D Woods in a mixed animal practice in Dargaville, Northland, New Zealand, and I held a special interest in bovine mastitis and dairy cattle reproduction. I was fascinated by how many cases of clinical mastitis or mastitis problem herds were in the area. Anecdotal evidence from veterinarians and laboratory workers from the region suggested that there might be different patterns of mastitis in Northland to those observed elsewhere in New Zealand. The idea to conduct a study on the aetiology of bovine mastitis for the region was thus born. It took more than a year to find someone willing to provide financial support and to start the first study. After that, it was easier to find extra financial support. At this stage I contacted Prof Tim (Timothy) J. Parkinson, who invited Assoc Prof Cord Heuer also to be involved. At this stage both veterinary practices in Dargaville amalgamated causing an additional pressure of changing the working environment and habits. Conducting the study, I found why people are reluctant to work on larger scale studies while employed full time in a practice. There was no time for a private life, especially since I was recently married. Fortunately, my wife, Paulina Rodriguez, was also preoccupied as she was preparing for the New Zealand National Veterinary Examination registration exams. She did not complain (hugely) about the extra hours that I spent with my "girlfriend" (my computer) or with my "love" (dairy farms).

Only due to the valuable time contributed by farmers and farm personnel on the study farms made it possible to conduct and complete this study. I truly enjoyed the discussions with them and the farm visits.

Furthermore, browsing the literature, I found that there is a great deal of literature available on the economics of bovine mastitis, but there is a lack of review/continuing education articles that provide a list of the factors associated with the cost of bovine mastitis to the dairy industry. This provided the inspiration for me to review the literature for these factors and subsequently write an article on continuing education. After a year or so of work, with help of two of my friends from my University days - Prof Metodija Trajcev and Prof Gjoko Buneski of Univeristy "St Cyril and Methodius",

Skopje, Macedonia, the first version was sent to the editor of the Journal of the South African Veterinary Association.

In late January 2006, my wife and I left Dargaville and moved to Palmerston North, where I joined the team of the Institute of Veterinary, Animal and Biomedical Sciences, Massey University. My close collaboration with Prof Norman B. Williamson at Massey University completed the expansion of my supervisors team. My interest in the economics of bovine mastitis formed the basis of the second study included in this thesis – investigating the effects of clinical mastitis occurring in the early dry period on the milk production in the subsequent season. A study on the efficacy of an experimental and a modified existing external teat sealant, conducted over a previous dry period by Cecilia Fernandez, provided a great opportunity to investigate any production effects after *Streptococcus uberis* challenge and infection.

At this stage I started with my biggest saga during the preparation of this thesis - the analytical part of the studies. I learned that data preparation and proper analyses are very important. Collecting the data is easier than the data entry that can be a very difficult task, particularly when the collected data are on hand-written forms. This was succinctly stated by Prof Ynte Schukken from Cornell University, USA, at a February 2007 Epidemiology workshop when he said "You enter your data preparing it for analysis, not just to be entered". This is something that I had to learn the hard way, during my Masters preparation.

Analyses in the second study were conducted with guidance and assistance on the use of SAS software from Dr Nicolas Lopez-Villalobos. Mr Alex Grinberg was also involved in the study, providing some information in the absence of Cecilia Fernandez, who had returned to Argentina. I found computer software to be very helpful and fast, however, I am not sure that in my next life I would like to be a statistician.

This Masters project has been one of the most enjoyable educational experiences that I have undertaken. The knowledge gained and the techniques learned (in particular biostatistics), have provided an opportunity to investigate problems that were previously impossible for me to tackle. I am now able to approach problems in a more logical manner. I have gained skills and confidence to learn many more techniques of

the discipline under my own guidance and this will be basis for my further development.

Writing is an essential part of any research and it is often very difficult to bring the observations and analyses to other people, particularly in a foreign language as English is my second (or so) language. Ross Woods, George Tharakan, Kathy Dropulich, Kylie Martinovich, Donald Thomas, Graeme Ewenson, Simeon Pollock and Joyce DeMoulin from Dargaville, Prof Colin Holmes, Assoc Prof Duncan Mackenzie, Mr Allan Thatcher, and my supervisors, at Massey have been of tremendous help reading papers, manuscripts and this thesis and have suggested useful corrections. Prof Williamson once mentioned that my first versions of manuscripts are in Macedonian with English words.

Dedication

I would like to dedicate this thesis to my parents Risto and Verica Petrovski for their guidance and encouragement through my life and my wife Paulina Rodriguez for her love and patience.

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I wish to express my sincere gratitude to my supervisors Prof Tim Parkinson, Prof Norm Williamson and Assoc Prof Cord Heuer, for their patience, sound advice, encouragement, dedication and for leading me through the intricacies of a master's degree thesis.

I am indebted to all the farm owners and farm personnel in the enrolled dairy farms for the friendship, cooperation and interest in my research. Without their full support and cooperation this work could not have been carried out.

I would also like to thank the Dargaville Veterinary Centre crew for their assistance and encouragement during the field work on the second study.

I would also like to thank the New Zealand Veterinary Pathology laboratory crew of Michelle McKeany and Rae Pearson for their assistance in culturing the samples and identification.

Assoc Prof Duncan Mackenzie and Prof Colin Holmes are also thanked for their guidance and encouragement through my post graduate studies. Andrea Coleman has provided computer support and Dr Nicolas Lopez-Villalobos, Dr Richard Laven and Kevin Lawrence have provided assistance with the statistical analysis of the data.

Other Institute of Veterinary, Animal and Biomedical Sciences, Massey University staff, although not directly involved in my studies, have also provided support and friendship through my studies.

The financial support provided by the Northland Community Foundation in cooperation with the Northern Wairoa Vet Club, Dargaville Field days and Mangatapere Vet Club for the Northland study is also gratefully acknowledged.

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List of Abbreviations

Abbreviation	Meaning
A.	*Arcanobacter*
BTSCC	Bulk Tank Somatic Cell Count
CM	Clinical Mastitis
CNS	Coagulase-negative staphylococci
CR-FVR	Case-ratio of clinical mastitis in front *versus* rear quarters
CR-RVL	Case-ratio of clinical mastitis in right *versus* left quarters
DAR	Days at risk
DIM	Days in milk
E.	*Escherichia*
EDPCM	Early Dry Period Clinical Mastitis
HF	Holstein-Friesian
ICSCC	Individual cow somatic cell count
IMI	Intramammary Infection
IVABS	Institute of Veterinary, Animal and Biomedical Sciences
LIC	Livestock Improvement Corporation
MCO	Mastitis-Causing Organism
MS	Milk solids
MUAEC	Massey University Animal Ethics Committee
S.	*Staphylococcus*
SAS	Statistical Analysis System
SCC	Somatic Cell Count
SCM	Sub-clinical Mastitis
SCS	Somatic cell score
Strep.	*Streptococcus*
UK	United Kingdom
USA	United States of America