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Epidemiological studies of enteropathogens of newborn calves in New Zealand dairy farms

Julanda Al Mawly
2014
Epidemiological studies of enteropathogens of newborn calves in New Zealand dairy farms

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

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ABSTRACT


This PhD thesis comprises an overview of the literature pertinent to the principles of calf rearing in dairy farms, and the major infectious and non-infectious causes of neonatal calf diarrhoea (Chapter 1 and 2), followed by accounts of four epidemiological studies of neonatal calf diarrhoea in New Zealand dairy farms (Chapters 3-6). The first study assessed the utility of halofuginone lactate for the prevention of cryptosporidiosis in the presence of co-infection (Chapter 3), and the following two studies investigated the prevalence of the common enteropathogens of calves, and risk factors for neonatal calf diarrhoea in New Zealand dairy farms. The final study describes a molecular analysis of Cryptosporidium parasites isolated from calves, and a genetic comparison with human C. parvum clinical isolates collected by diagnostic laboratories in the same regions.

The results of the first study highlight the limitations of the use of halofuginone lactate for the prevention of cryptosporidiosis of calves in the presence of co-infection. The prevalence study provides epidemiologically robust estimates of the national prevalence of calf enteropathogens in dairy farms and the risk factor analysis identified a number of potential risk factors for neonatal calf diarrhoea pertaining to infection status, colostrum management, infrastructure and even human resource management. Finally, the molecular analysis of Cryptosporidium indicate that C. parvum is the predominant species cycling in newborn calves in New Zealand. The significant genetic similarities between human and bovine C. parvum observed in this project support the model considering young calves as amplifiers of potentially zoonotic C. parvum in New Zealand.

This project provides new data on the prevalence of the enteropathogens of newborn calves and the risk factors for neonatal calf diarrhoea in dairy farms, which can be used by the New Zealand industry to target interventions aimed at improving animal health, welfare and productivity. This PhD project represents the first large scale epidemiological study of neonatal calf diarrhoea performed in New Zealand and to the author’s knowledge, one of the most comprehensive national studies, worldwide.
The initial objective of this PhD project was to study the epidemiology, molecular epidemiology and control of cryptosporidiosis in newborn calves in New Zealand. The first study aimed at evaluating the efficacy of halofuginone lactate for disease prevention. The study was performed on a dairy farm in Taranaki, which had been selected in view of the presence of cryptosporidiosis and an absence of rotavirus, and Salmonella among winter calves before the spring calving season. However, faecal specimens submitted for analysis at the beginning of the study tested positive also for rotavirus, Salmonella and Giardia spp. This result, initially considered a drawback, allowed a study of the efficacy of halofuginone lactate in the presence of co-infections with other enteropathogens, which has been previously poorly characterised. Furthermore, this diagnosis prompted an expansion of the scope of this PhD project, to a more comprehensive study of neonatal calf diarrhoea, including studies of the aetiology and risk factor for this important condition.
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<td>Bovine rotavirus</td>
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<tr>
<td>BCV</td>
<td>Bovine coronavirus</td>
</tr>
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<td>K99</td>
<td>Enterotoxigenic <em>E. Coli</em> K99</td>
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<tr>
<td>C. parvum</td>
<td><em>Cryptosporidium parvum</em></td>
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<td>spp</td>
<td>Species</td>
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<td>HL</td>
<td>Halofuginone lactate</td>
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<td>KM</td>
<td>Kaplan–Meier analysis</td>
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<td>ANOVA</td>
<td>Analysis of variance</td>
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<td>EHEC</td>
<td>Enterohaemorrhagic <em>E. Coli</em></td>
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<td>EPEC</td>
<td>Enteropathogenic <em>E. Coli</em></td>
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<td>EIEC</td>
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<td>DAEC</td>
<td>Diffusely adherent <em>E. Coli</em></td>
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<tr>
<td>ETEC</td>
<td>Enterotoxigenic <em>E. Coli</em></td>
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<tr>
<td>stx</td>
<td>Shiga toxin</td>
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<tr>
<td>bp</td>
<td>Base-pairs</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>GP60</td>
<td>Glycoprotein (or 60-kDA glycoprotein)</td>
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<tr>
<td>HSP70</td>
<td>70 kDa Heat Shock Protein gene</td>
</tr>
<tr>
<td>IVABS</td>
<td>Institute of Veterinary, Animal and Biomedical Sciences</td>
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<td>MU</td>
<td>Massey University</td>
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<tr>
<td>OPG</td>
<td>Oocysts per gram of faeces</td>
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<td>TON</td>
<td>Total oocysts number</td>
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<tr>
<td>PCR</td>
<td>polymerase chain reaction</td>
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<tr>
<td>RFLP</td>
<td>Restriction fragment length polymorphism</td>
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<td>UV</td>
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<td>XLD</td>
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<td>18S rRNA</td>
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Almawly J., Prattley D., French N.P., Grinberg A. Field trial of the utility of full and half dosage regimens of halofuginone lactate for the prevention of calf cryptosporidiosis. Presentation at the IV International Giardia and Cryptosporidium conference held in Wellington in 2011.
