BRIEF COMMUNICATION: Mastitis pathogens isolated from dairy cattle that were managed on conventionally or organically maintained matched farmlets

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Introduction

Mastitis is a common disease of dairy cattle causing significant economic loss (Seegers et al. 2003), which has been estimated to cost the New Zealand dairy industry $180 million annually (Malcolm 2006). It has been shown that dairy cattle in the first lactation are particularly susceptible to infections from environmental pathogens, including *Streptococcus uberis* (Woolford & Lacy-Hulbert 1996) and that this was the most common environmental pathogen, involved in the development of clinical mastitis of dairy cattle in New Zealand (Pankey et al. 1982, 1996; McDougall,1999). Studies completed in the Waikato region of New Zealand described the pathogens isolated from dairy cattle with clinical mastitis and reported that 27 to 75% of cases were infected with *Streptococcus uberis*, whereas 9 to 10% were *Coagulase-negative-staphylococci* (CNS), 3 to 5% were *Staphylococcus aureus*, 2 to 5% were coliforms and finally 1.5 to 4 % were *Strep. dysgalactiae* (McDougall 2003, 2007; Compton et al. 2007).

Several researchers have compared the incidence of mastitis in organically and conventionally managed dairy farms, with varying results. The majority of researchers found that there was less mastitis in organic compared to conventional dairy farms (Hamilton et al. 2002; Bennedsgaard et al. 2003, Hamilton et al. 2006), though one study reported negligible differences (Hardeng & Edge 2001), and a farm survey reported higher levels of somatic cell counts (SCC) in organic compared to conventional dairy herds (Hovi & Roderick 2000). These studies were, however, limited by the collection of data from a selection of farms operating organically or conventionally managed dairy herds. These would be confounded by differing management, equipment and farm practices. Moreover, these studies used SCC from herd tests and only reported pathogens isolated from some of the quarters that were observed to have been infected with clinical mastitis.

This study aimed to assess individual quarter milk samples, that were collected from the individual quarters at 1, 14, 130 and 260 days in milk (DIM) from of dairy cattle that were organically and conventionally managed on two matched farmlets that were milked with the same milking equipment and managed by the same farm manager.

Materials and methods

The experiment was completed between August 2010 and May 2011 at the Massey University dairy cattle research unit, Palmerston North, New Zealand, in accordance with the Massey University Animal Ethics Committee. The research unit consisted of 41.7 ha of useable land, which was subdivided into matched farmlets of 25 organically and 25 conventionally managed paddocks ranging in area from 0.08 to 1.53 ha with a mean size of 0.83 ha. The paddocks were established pasture that had supported dairy cows for nine years prior to the commencement of this study. The pastures consisted of a combination of perennial ryegrass (*Lolium perenne)*, white clover (*Trifolium repens)* and other weed grass species such as *Poa annua*. Each paddock was grazed every 15 to 25 days in a rotational grazing system. There were 46 lactating cows grazed on the organically managed farmlet and 50 lactating cows grazed on the conventionally managed farmlet. The cows were Friesian and Friesian x Jersey cross between 2 and 10 years of age. The number of cows of each age in the organic and conventionally managed farmlets was two-year-old (9, 9); three-year-old (13, 12); four-year-old (0, 8); five-year-old (6, 6); six-year-old (15, 6); seven-year-old (0, 4); eight-year-old (1, 3); nine-year-old (1, 1) and ten-year-old (1, 1) respectively. The California rapid milk test (RMT) was applied to pre milking hand stripped milk samples, which were assessed, in accordance to standard procedures (Giesecke et al. 1994), as positive. Hand-stripped, 20 mL milk samples were collected from each quarter aseptically prior to machine milking at 1, 7, 14, 130 and 260 days in milk for pathological assessment. Each sample was transferred directly into an insulated cold box and transported directly to the ISO accredited pathology laboratory, at Massey University, for pathogen identification according to standardised procedures. A bulk milk SCC count was assessed from daily milk consignments, using an electronically automated cell counter (Fossomatic 5000, Foss Electric, Montgomeryville, Pennsylvania, USA). The presence of each mastitis pathogen, which was treated as a binomial trait (0 = Absence, 1 = Presence) at the quarter level, was modelled using the GLIMMIX procedure of SAS (Statistical analysis system, version

Table 1 Number of cows in each lactation group and the percentage of quarters ± standard error of the mean identified as being positive by the California rapid milk test (RMT) for clinical mastitis across all samplings within the organically and conventionally managed farmlets and the mean somatic cell count (SCC).

Measurement	Lactation number	Number of cows		Management		P value
		Organic	Conventional.	Organic	Conventional	
Positive RMT test (%)	1	9	9	6.7 ± 2.8	6.2 ± 2.6	0.90
	2	13	12	0.7 ± 0.6	1.9 ± 1.0	0.30
	3 + 4	6	14	0.0 ± 2.0	1.9 ± 0.9	0.53
	≥5	18	15	5.1 ± 1.6	5.2 ± 1.8	0.97
SCC (‘000 cells/mL)		46	50	142	139	-

Table 2 Percentage of quarters ± standard error of the mean that had mastitis related pathogens isolated from milk samples collected at 1, 14, 130 and 260 days in milk, from dairy cattle in differing lactations that were maintained on organically and conventionally matched farmlets. P values in bold indicates significance at P <0.05. P values in italics indicates approaching significance between P = 0.05 and P = 0.10. CNS = Coagulase negative staphylococcus species.

Pathogen	Lactation number	Management		P value
		Organic	Conventional	
CNS	1	36.6 ± 7.7	21.4 ± 5.8	0.12
	2	20.0 ± 4.6	17.1 ± 4.4	0.65
	3 + 4	23.6 ± 7.4	16.4 ± 3.9	0.37
	≥5	19.2 ± 3.8	14.8 ± 3.6	0.40
	Overall	24.3 ± 3.0	17.3 ± 2.2	*0.06*
Bacillus spp.	1	4.0 ± 1.8	7.2 ± 2.6	0.32
	2	6.2 ± 2.0	9.9 ± 2.8	0.27
	3 + 4	10.0 ± 4.0	7.1 ± 2.1	0.48
	≥5	2.9 ± 1.1	10.9 ± 2.7	**0.002**
	Overall	5.3 ± 1.0	8.6 ± 1.3	**0.04**
Strep. uberis	1	3.6 ± 1.7	2.0 ± 1.2	0.43
	2	1.9 ± 1.0	2.7 ± 1.2	0.62
	3 + 4	7.8 ± 3.5	2.2 ± 1.0	**0.05**
	≥5	4.4 ± 1.4	2.9 ± 1.2	0.41
	Overall	4.0 ± 0.9	2.4 ± 0.6	0.12
Staph. aureus	1	0.6 ± 0.6	0.6 ± 0.6	1.00
	2	0.8 ± 0.6	0.9 ± 0.7	0.94
	3 + 4	0.9 ± 1.0	1.5 ± 0.9	0.87
	≥5	2.6 ± 1.1	1.9 ± 1.0	0.66
	Overall	1.1 ± 0.5	1.1 ± 0.4	0.89

9.3; SAS Institute Inc., Cary, North Carolina, USA) following a logit transformation. The model included the fixed effects of system (organic and conventional), lactation number (1, 2, 3+4 and ≥5), days in milk (1, 7, 14, 130 and 260), the interaction between system and lactation number, and the random effect of cow. Back-transformed marginal means and standard errors for each production system and lactation number were obtained and used for the multiple comparisons, and significant differences were declared at P <0.05.

Results

The mean bulk milk SCC was relatively low and there was no difference in the SCC or the number of positive quarters, according to the RMT, between organic and conventionally managed cows (Table 1). The overall percentage of quarters that had the main pathogens isolated from the quarter milk samples (Table 2) were CNS, *Bacillus spp*., *Strep. uberis* (Table 2), whereas *Staph. aureus* was less frequently isolated. Overall the lactations, the percentage of quarters infected with CNS tended to be higher (P = 0.06) in organically managed, compared to conventionally managed dairy cattle. However there were no differences between organically and conventionally managed quarters according to lactation group. Whereas the overall percentage of quarters infected with *Bacillus spp*. was higher in conventionally managed cattle compared with organically managed cattle. In terms of lactation groups, conventionally managed cows in their fifth or

later lactation had higher percentage of quarters infected with *Bacillus spp*. The overall percentage of quarters infected with *Strep. uberis* did not differ between management systems, however organically managed cows in their third and fourth lactations had a greater percentage of quarters infected with *Strep. uberis* compared with conventionally managed cows. There was no difference in the percentage of organically and conventionally managed quarters infected with *Staph. aureus.*

Discussion

The observation that CNS and *Strep. uberis*, were the main pathogens associated with mastitis isolated from milk samples in this study was in agreement with previous studies in New Zealand (Pankey 1996; McDougall 1998). In this study the percentage of quarters infected by CNS was high compared with other pathogens, but did not differ significantly ($P < 0.05$) between cows in differing lactations or between organically and conventionally managed animals. This differed to previous research that has shown a greater incidence of CNS in first lactation dairy cattle (Pippers et al. 2007). Organically managed cows in their third and fourth lactation had a greater percentage of quarters infected by *Strep. uberis* than conventional cows in their third and fourth lactations ($P = 0.05$). Whereas the organically managed cows had a lower incidence of quarters infected by *Bacillus spp.* in cows in their fifth and later lactations ($P = 0.002$) and across all lactations ($P = 0.04$) than conventionally managed cows (Table 2).

Conclusions

Overall, there were few differences in pathogen levels in milk in organically and conventionally managed animals. However, in this production season, organically managed cows were more frequently infected with *Strep. uberis*. Whereas, *Bacillus spp* were isolated more frequently from conventionally managed cows, especially in their first and in their fifth and later lactations.

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