Teat spraying prior to calving may reduce the risk of heifer mastitis caused by *Streptococcus uberis*

M.G. LOPEZ-BENAVIDES, J.H. WILLIAMSON, S.J. LACY-HULBERT AND R.T. CURSONS[1]

Dexcel Limited, Private Bag 3221, Hamilton, New Zealand

ABSTRACT

Heifer mastitis caused by *Streptococcus uberis* is a significant problem for New Zealand dairy farmers. The mechanisms of infection in the pre-partum period have not been fully elucidated but prior research has established that the teats of dairy cows are contaminated with significantly higher numbers of *S. uberis* during the dry period as compared to during lactation. It is hypothesised that gross teat-end contamination by these bacteria before calving is a significant risk factor for the entry of bacteria through the teat canal and establishment of infection. Regular disinfection of the teats in the dry period was evaluated as a means to reduce teat-end contamination and consequently to decrease the likelihood of glands developing an infection. Two groups of 27 heifers were assigned to either a 'sprayed' or 'not-sprayed' treatment. The sprayed heifers were teat-sprayed with a commercial iodine-based post-milking teat sanitizer three times a week for the last three weeks before calving. Before commencement of the experiment, teat-ends were swabbed to determine pre-existing contamination with *S. uberis*, which averaged 610 colony-forming units (cfu). Prior to calving, *S. uberis* counts on teat-ends were 560 cfu for the sprayed group and 1775 cfu for the non-sprayed group ($p = 0.06$). Bacteriology of milk from each gland at the first milking showed that 4% of glands of the sprayed heifers were infected with *S. uberis* compared with 11% for the non-sprayed heifers ($p < 0.05$). At the first herd test, heifers in the sprayed group had a lower SCC (380,000 cells/ml) compared to the non-sprayed group (790,000 cells/ml), although due to the small size of the study, this difference was not significant. It was concluded that teat-spraying in the dry period could reduce teat-end contamination and consequently the proportion of glands infected by *S. uberis* at calving.

Keywords: heifers; mastitis; teat spraying; dry period; pre-partum

INTRODUCTION

Heifer mastitis is a significant problem for New Zealand dairy farmers and *Streptococcus uberis* is the pathogen most commonly associated with the disease (McDougall, 1999; McDougall, 2002). In a survey of Waikato farms, Pankey *et al*. (1996) found that around 12% of heifers were positive for environmental streptococci when sampled after calving and McDougall (1999) showed that heifers and second lactation cows were at a significantly higher risk of clinical mastitis (CM). The mechanisms of infection pre-partum have not been elucidated, but studies have identified that udder oedema and milk leakage pre- and post-partum are risk factors for heifer mastitis caused by *Staphylococcus aureus* (Waage *et al.*, 2001). In New Zealand, those risk factors have not been explored in detail, but a survey of Waikato and Taranaki dairy farmers identified risk factors associated with CM in heifers. These included average production/cow, cows/milking person, single milking mobs, stocking rate and number of cows with CM (Parker *et al.*, 2005). Additionally, a longitudinal study of around 700 heifers identified other risk factors for post-calving infection that included pre-existing intramammary infection (IMI), breed differences and teat length (Parker *et al.*, 2005). Nevertheless, for *S. uberis* mastitis, the environment plays an important role, and high *S. uberis* populations in the environment in winter (Lopez-Benavides *et al*., 2005) and higher contamination of teats by *S. uberis* in the dry period than in the lactation period (Lacy-Hulbert *et* al., 2005) may be partly responsible for the high prevalence of *S. uberis* mastitis in heifers calving in spring.

Reducing teat-end contamination by *S. uberis* in the pre-partum period may help reduce the risk of cows developing subclinical mastitis (SCM) or CM at calving. This reduction could be achieved by modifying existing mastitis control strategies such as teat spraying, which are effective for controlling contagious mastitis pathogens and also environmental streptococci (National Mastitis Council, 2004). The objective of this study was to evaluate the use of an iodine-based teat sanitizer applied in the pre-partum period to reduce *S. uberis* contamination on the teats of heifers. Additionally, bacteriology of mammary glands at calving and

[1]University of Waikato, Hamilton, New Zealand

somatic cell count (SCC) at the first cow herd test was recorded and assumed to be the consequence of controlling the bacteria in the pre-partum period.

MATERIALS AND METHODS

Animals and experimental design

A total of 54 primiparous monozygotic twins were selected from the Dexcel Lye Farm for the study. A twin member was randomly assigned to a 'sprayed' treatment and the other member to a 'not sprayed' control group. Heifers were grazed in the same paddock and were brought to the dairy at approximately three weeks before the due calving date on three days of each week, on Monday, Wednesday and Friday. On each of these days, all teats of the 'sprayed' group were sprayed once with an iodine-based teat sanitizer (Teatguard Plus®, Ecolab) at the dilution recommended for lactating animals. After teat spraying, the animals were released for grazing. Apart from the movement of stock to the dairy three times a week, animal management was the same as for other dry cows on the farm. All animal manipulations were approved by the Ruakura Animal Ethics Committee. GenStat Release 8.1 (VSN International, Oxford, England) was used to analyse the data. ANOVA was used to compare teat swab counts between the two treatments, and regression analysis with binomial proportions was used to compare the proportion of quarters infected with *S. uberis* at the first milking. Teat swab counts and SCC values were $\log_{10}$ transformed prior to statistical analysis.

S. uberis isolation and enumeration from teat swabs

One teat from each animal was randomly selected to monitor *S. uberis* population changes during the peri-calving period. Using a sterile cotton-tipped swab previously moistened with 0.1% peptone diluent, this teat-end was vigorously swabbed at the following times: start of the experiment, at or near (within 48 h) calving, and one week after calving. At the laboratory, the cotton tip was removed using scissors previously cleaned with 70% ethanol and placed into a 1.5 ml Eppendorf tube. A 1 ml volume of UHT skim milk was then added and the tube was vortex mixed for one minute to release bacteria into the milk. A 100 µl volume was then spread plated onto a *S. uberis* selective media (Pullinger *et al*., 2006) and left to dry for five minutes before incubating at 37°C for 72 h, when *S. uberis* colonies could be enumerated. Bacterial counts on plate were recorded as colony-forming units (CFU)/swab.

Milk bacteriology and herd test somatic cell count

After calving and before the first milking, each heifer was sampled in the following way: the selected teat was first swabbed as described previously to determine bacterial contamination of the teat-end. All teats were then scrubbed with cotton-wool soaked in 70% ethanol and left to dry before collecting approximately 15 ml of milk from each gland into a sterile container for bacteriological analysis. In the laboratory, 10 µl of each milk sample was plated onto Esculin Blood Agar and incubated at 37°C for 48 h (National Mastitis Council, 1999). A quarter was categorised as either being positive or negative for the presence of *S. uberis*, depending on the appearance of typical *S. uberis* colonies on the media. Heifer SCC value was obtained from the first herd test sampling, which was on average 11 days after calving.

RESULTS

Streptococcus uberis contamination of teat-ends

Contamination of teat-ends varied at the different swabbing times. At the beginning of the experiment, teat-end contamination was around 610 CFU/swab for both groups ($p = 0.78$). Heifers were enrolled in the experiment for an average of 23 days prior to calving, during which time the 'sprayed' group was treated nine times. At calving, *S. uberis* counts were 560 and 1775 CFU/swab for the 'sprayed' and 'not sprayed' groups, respectively ($p = 0.056$). On average, teats were swabbed two days prior to calving. Once the cow joined the milking herd, teats were swabbed again about 11 days after calving at which point, teat-end contamination was similar between both groups, at 30 CFU/swab ($p = 0.52$) (Table 1).

Streptococcus uberis mastitis and somatic cell count at the first herd test

Bacteriology of all glands from both treatments is shown in Table 2. In total, 3.7% of the glands in the 'sprayed' group were infected with *S. uberis* before the first milking compared to 11.1% of the 'not sprayed' group ($p < 0.05$). Heifers were herd-tested within two weeks of calving and SCC values averaged 375,000 cells/ml for the 'sprayed' group and 787,000 cells/ml for the 'not sprayed' group ($p = 0.43$) (Table 2).

TABLE 1: *Streptococcus uberis* contamination of teat-ends at 3 weeks pre-partum, at calving and 2 weeks post-calving in heifers 'sprayed' or 'not sprayed' with teat-sanitizer during the pre-partum period. Values expressed are colony-forming units (CFU)/swab (± SD)

Treatment	Start of Experiment (p = 0.78)		Prior to Calving (p = 0.056)		Milking (p = 0.52)	
	Animals (n)	CFU/swab	Animals (n)	CFU/swab	Animals (n)	CFU/swab
Sprayed	27	648 ± 848	26	558 ± 1440	27	25 ± 123
Not Sprayed	27	570 ± 742	26	1775 ± 3490	26	32 ± 121

TABLE 2: Proportion of glands (± SED) diagnosed with *S. uberis* intramammary infection (IMI) at the first milking in heifers that were either 'sprayed' or 'not sprayed' with teat sanitizer in the pre-partum period, and SCC values (± SD) observed at the first herd test.

Treatment	Total Glands (n)	Glands with *S. uberis* IMI SED = 0.035 (p = 0.034)		First Herd Test (p = 0.43)	
		n	Proportion	Heifers (n)	SCC (x 1000 cells/ml)
Sprayed	108	4	0.037	27	375 ± 688
Not Sprayed	104	12	0.111	26	787 ± 1495

DISCUSSION

This study showed that teat-end contamination during the pre-partum period is a risk factor for *S. uberis* mastitis in heifers. Heifers teat-sprayed at a frequency of three times a week for three weeks prior to calving showed a significant decrease in the contamination of teats by *S. uberis* compared to the 'not sprayed' group. This decrease in teat-end contamination was associated with, or resulted in, a lower proportion of glands infected with *S. uberis* at calving and subsequently, although not significant, a lower SCC at the first herd test.

Managing *S. uberis* heifer mastitis is particularly important for dairy farmers. Mastitis in the first lactation can compromise the life-time production of a heifer (Woolford *et al*., 1984) and may compromise the future survivability of the animal within the herd (De Vliegher *et al*., 2005). Modifying existing management tools, such as teat spraying in the dry period may help reduce the economic burden of early season CM. Additionally, although it was not part of the study, it was observed that bringing heifers to the dairy prior to calving may have helped to acclimatise the animals to the noise, milking environment and human contact associated with milking, and reduced the effect of these stressors on the animals during the colostrum period. This study demonstrated that managing *S. uberis* populations on the teat at high-risk periods can have a beneficial effect on udder health at calving. Larger scale studies across commercial farms are needed to validate the concept of pre-partum teat spraying for decreasing the incidence of *S. uberis* CM at calving.

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