Subclinical mastitis in dairy ewes

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Introduction

There were an estimated 30,000 ewes being milked on approximately 30 farms in 2022 (McCoard *et al.* 2023). Compared to the dairy cow industry, published research on milk quality and mastitis in dairy ewes is scarce, particularly for grazing systems like in New Zealand. The gap in milk quality and mastitis data means we must extrapolate from cattle studies or from dairy sheep systems different to our own. Subclinical mastitis is a significant concern for sheep dairy producers because it has been shown to affect milk quantity and quality (Leitner *et al.* 2004; Alba *et al.* 2019; Michael *et al.* 2023) and the quality of products made from sheep milk such as cheese (Jaeggi *et al.* 2003). Definitions of subclinical mastitis vary but require a positive milk culture and usually an elevated somatic cell count (SCC) and/or rapid mastitis test (RMT) and/or elevated milk neutrophil and lymphocyte proportions. Our objectives were to systematically describe milk bacteriology results and the prevalence of and risk factors for subclinical mastitis on New Zealand sheep milking farms.

Methods

We conducted a repeated cross-sectional study on 20 commercial New Zealand sheep milking farms. The farms were selected to represent a range of locations and systems and have been previously described (Chambers *et al.* 2024). In brief, all farms were seasonal, and lambing occurred entirely in the spring except for one farm that also had an autumn-lambing flock. The median peak number of ewes milked per farm was 790 ewes, ranging from 171 to 1,530 ewes. All ewes lambed outdoors except on three farms, which lambed selected ewes indoors (e.g. ewes bearing triplets, one-year-old ewes, or other ewes during bad weather). Visits were planned on three occasions on each farm during the 2022/2023 lactation season: August–October 2022 (visit 1), November–December 2022 (visit 2), and March 2023 (visit 3), corresponding to the early, mid, and late lactation periods respectively. Gland-level milk samples were collected from approximately 15 randomly selected ewes on each farm at early, mid, and late lactation. Subclinical mastitis was defined at the ewe level as having 1 or 2 bacteriologically positive glands and a somatic cell count >500x10^3 cells/ml and/or a rapid mastitis score ≥1.

Ewes were body condition scored on a 5-point scale, with increments of 0.5. Teat and udder morphology and pathology assessments were performed as described by Chambers *et al.* (2025). Briefly, morphological assessments included teat length and width (both measured in mm), and udder depth, udder suspension, udder separation, and teat placement (all measured on a 5-point scale). Udder symmetry was subjectively assessed as either symmetrical or asymmetrical. Pathology assessments comprised presence of lesions of the teats and udder, teat and udder palpation findings, presence of teat and udder inflammation, and teat end hyperkeratosis. The RMT was performed on farm, measured on a scale of 0, trace, 1, 2, and 3. Sterile milk samples were collected from each gland. Subsamples were frozen and shipped to Massey University for bacterial culture and matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOF). The remaining milk from each gland was combined into a single composite sample, gently mixed, and then sent to MilkTestNZ for SCC analysis.

Farm managers were interviewed to obtain farm-level risk factor information (farm management practices, milking procedures, flock characteristic, and ewe health).

Somatic cell count, RMT results, and culture results were analysed descriptively. The prevalence of subclinical mastitis was calculated by regression modelling. Risk factors for subclinical mastitis were also determined by

regression modelling, with and without udder symmetry included as a risk factor (since it is a consequence of mastitis, not technically a risk factor, but may be used by farmers to screen ewes).

Results

Across the three visits, 893 observations were made on 882 unique ewes. The median (IQR) SCC was 128,000 (75,250- 264,500), the geometric mean was 169,039 (SD = 201,326) cells/ml, and the range was 2,000 - 34,953,000 cells/ml. There were 1,069 (60.8%), 418 (23.8%), 121 (6.9%), 86 (4.9%), and 63 (3.6%) glands having RMT scores of 0, trace, 1, 2, and 3 respectively. Milk samples from 1,763 glands were submitted for culture. MALDI-TOF was performed on 103 samples after removing samples with no growth (n=1,650) and contaminated samples (n=10). Bacteria were identified in 97/1,763 (5.5%) glands (Table 1). Non-aureus staphylococci (NAS) were the most common isolates, being confirmed in 71/1,763 (4%) glands, followed by *S. aureus* in 10/1,763 (0.6%) glands. Other species were found in 16/1,763 (0.9%) glands. *S. aureus* was found on 5/20 (25%) and NAS on 16/20 (75%) farms.

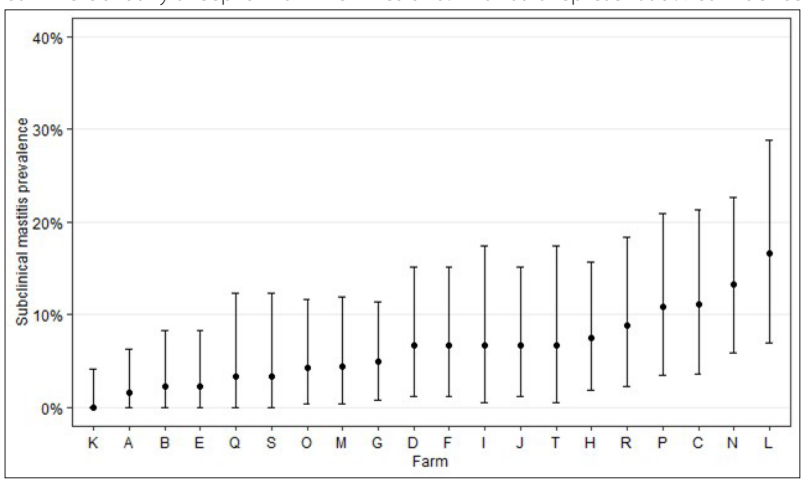
Table 1. Results of microbiological culture of gland-level milk samples (n=1,763) in a study of udder health of randomly selected ewes (n=893) on 20 commercial dairy sheep farms in New Zealand.

Aetiology	N (%)
No growth	1,650 (94%)
Staphylococcus warneri	17 (1.0%)
Staphylococcus caprae	16 (0.9%)
Staphylococcus aureus	10 (0.6%)
Contaminated	10 (0.6%)
Staphylococcus auricularis	7 (0.4%)
Staphylococcus haemolyticus	7 (0.4%)
Staphylococcus devriesei	6 (0.3%)
No ID possible	6 (0.3%)
Staphylococcus epidermidis	5 (0.3%)
Staphylococcus simulans	5 (0.3%)
Staphylococcus chromogenes	4 (0.2%)
Streptococcus uberis	4 (0.2%)
Escherichia coli	2 (0.1%)
Staphylococcus xylosus	2 (0.1%)
Streptococcus infantarius	2 (0.1%)
Bacillus licheniformis	1 (<0.1%)
Citrobacter gillenii	1 (<0.1%)
Enterococcus hirae	1 (<0.1%)
Kocuria atrinae	1 (<0.1%)
Lactococcus lactis	1 (<0.1%)
Serratia marcescens	1 (<0.1%)
Serratia nematodiphila	1 (<0.1%)
Staphylococcus caprae & Staphylococcus warneri	1 (<0.1%)
Staphylococcus warneri & Staphylococcus epidermidis	1 (<0.1%)
Streptococcus ovis	1 (<0.1%)

The prevalence of subclinical mastitis was 6.4% (95% CI = 4.7-8.8%). The intraclass correlation coefficient (a measure of amount of variation explained by the farm effect) was low at 0.04. The farm-level prevalence ranged from 0.0% (95% CI = 0.0-4.2%) to 16.7% (95% CI =7.0-28.8%) (Figure 1), but a significant difference between farms was not confirmed (p =0.11). Teat end hyperkeratosis was the only variable with a significant association with subclinical mastitis in the model without udder symmetry. Ewes with group moderate or severe hyperkeratosis had 6.4-fold (95% CI = 1.5-27.5) higher odds of subclinical mastitis compared to ewes with no

or mild hyperkeratosis. When udder symmetry was included, teat end hyperkeratosis and visit were the only other variables in the final model. Ewes with group moderate or severe hyperkeratosis had a 7.6-fold (95% CI = 1.7 - 34.6) increase in the odds of subclinical mastitis and ewes diagnosed with asymmetric udders had 2.3-times (95% CI = 1.3-4.0) higher odds. The odds more than halved across visits, with ewes at visit 3 having 0.4-times (95% CI = 0.2-0.8) the odds of subclinical mastitis than ewes at visit 1.

Figure 1. Prevalence of subclinical mastitis on each farm in a study of udder health of randomly selected ewes (n=871) on 20 commercial dairy sheep farms in New Zealand. Error bars represent 95% confidence intervals.



Summary

The prevalence of subclinical mastitis was low in grazing New Zealand dairy ewes compared to overseas research. Bacteriology was dominated by NAS and *Staph. aureus*, suggesting that the causes are not substantially different more intensive systems in the northern hemisphere. Subclinical mastitis was not strongly clustered within farms, suggesting the need to focus subclinical mastitis management at the ewe level. Farmers should be aware of teat end health when managing or preventing mastitis. Udder symmetry is a useful visual screening tool for managing subclinical mastitis. However, teat end hyperkeratosis and udder symmetry are not perfectly accurate, reinforcing the importance of SCC in diagnosing and managing subclinical mastitis.

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