Association between Johne's disease milk ELISA status and milk production in Canadian dairy cows

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Introduction

Johne's disease (JD) is a chronic bacterial disease of ruminants. Most infected cows are subclinical, although most infections occur during calfhood. Clinical disease, which includes intermittend diarrhea and wasting, is observed in ≥ 2nd lactation. JD has been associated with decreased milk production in infected cows[1]. However, there are also contradicting reports in the literature, which report higher milk yields in test-positive dairy cows[2].

Objectives

1. to quantify the milk production differences between JD milk ELISA test positive cows and their test-negative herd mates
2. to determine if there is a difference in milk production in lactations preceding the lactation in which they tested positive

Materials & Methods

All milk ELISA tests conducted by CanWest Dairy Herd Improvement (DHI) between October 2005 and April 2009, as well as the cows' completed and ongoing lactation records were available for analysis. Some cows were tested more than once, therefore a test positive cow was defined as a cow that tested positive with the milk ELISA test at least once in her life. The lactation of her first positive test was used as the baseline or "current" lactation. Previous negative or subsequent positive tests were ignored. Test-negative and test-suspect cows were cows that never tested positive with the JD milk ELISA test. The lactation of their first available test was used as the baseline.

The milk production of test-positive cows was compared only to test-negative or suspect herd mates tested in the same lactation. Cows tested in their ≥7th lactation were combined due to low numbers. The estimated or actual 305 day milk yield (M305) was used as a standardized outcome for all lactations. Production records from lactations after the "current lactation" and those shorter than 60 days were excluded.

For each lactation (completed or current) a mixed linear model was fitted with the fixed effects: JD milk ELISA test result (test-positive, test-negative, test-suspect), calving season for that lactation and breed. Herd of origin nested in province was included as a random effect. The model assessing the relationship between JD test status and M305 in the current lactation included, as additional fixed effects, the stage of lactation (DIM) in 30 day intervals on test day as well as the number of the current lactation for cows tested in their ≥7th lactation. Differences between the different test results were evaluated using the least square means procedure.

The statistical analysis was conducted in SAS 9.2 (SAS Institute Inc., Cary, NC, USA). The significance level was set at $p < 0.05$.

Results & Discussion

Production and JD milk ELISA records of 36,793 cows from 371 herds were included in 28 linear mixed models.

In the current lactation test-positive cows in their 2nd to 6th lactation produced 2.6%, 3.2%, 3.8%, 5.8%, and 8.2% less milk than their test-negative herd mates (Table 1), respectively. Cows that tested positive in their second lactation produced more milk in their first lactation than their test-negative herd mates, while cows that tested positive in their 5th lactation produced less milk in the preceding lactation. Otherwise, the JD status was not associated with the M305 of lactations completed prior to the current lactation.

As the current lactation number increased, the difference in milk production between test-positive and test-negative cows also increased – in absolute numbers and proportionally.

Table 1: Differences in M305 (kg) between cows with different milk ELISA test results in the lactation the test occurred after accounting for season of calving, breed, province, stage of lactation as well as herd of origin

Lactation number in which cow was tested	Lactation number with differences in M305	Test Result		Difference in M305 *			
					95% CL		
		a	b	Mean	Lower	Upper	p-value
1	1	Negative	Positive	128.94	-29.3	287.2	0.1102
2	1	Negative	Positive	-160.3	-286.8	-33.7	0.0130
2	1	Positive	Suspect	349.9	-48.6	748.4	0.0853
2	2	Negative	Positive	262.7	10.6.9	418.5	0.0010
2	2	Positive	Suspect	-568.1	-1056.9	-79.2	0.0228
3	3	Negative	Positive	330.6	147.8	513.5	0.0004
4	4	Negative	Positive	401.6	147.1	656.1	0.0020
5	4	Negative	Positive	349.0	55.6	733.9	0.0226
5	5	Negative	Positive	601.4	240.3	962.5	0.0011
6	6	Negative	Positive	824.9	296.0	1353.9	0.0023

* Difference in M305 is between cows with the test result a vs. b

One explanation could be that older cows generally produce more milk than younger cows and might have been also more affected by the infection. Assuming that the cows were infected around birth, the surviving older cows will have been more capable of coping with the infection, and will have been generally healthier and more productive than herd mates. However, other stressors, such as the last calving, could have resulted in her reaching the "tipping point" from coping with the infection to succumbing to it in the lactation in which she tested positive. The lack of absorbed nutrients from the gut due to the infection could subsequently have led to the higher milk production loss than in young cows. Similar observations had been previously reported for cows with ketosis, where older cows were also less able to recover from a negative energy balance than young cows. However, for most cows only one test result was available and therefore, it is unknown if they would have tested positive previously and how that could have affected not only the classification of the cow but also the observed differences in milk production.

In **conclusion**, The JD test status of cows is associated with lower milk production in test-positive cows in the lactation in which they were JD milk ELISA test-positive.

References:
1. Hendrick et al. 2005. J. Am. Vet. Med. Assoc. 227:1302-1308
2. Wilson et al. 1993. Am. J. Vet. Res. 54:1851-1857
3. Rajala-Schultz et al. 1999. J. Dairy Sci. 82:288-294

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