Milk production losses associated with bovine paratuberculosis diagnosed from repeated testing

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Abstract

Infection with *Mycobacterium avium* subsp. *paratuberculosis* (MAP) can cause substantial production losses in dairy cattle. However, not all infected cattle experience economically important losses. Hence, if cows with MAP-production losses can be identified, it may be a rational strategy to restrict the control strategy to these cows. The objective of this study was to estimate MAP-associated milk production losses of cows classified into probable MAP states by means of repeated testing with a cheap and sensitive milk ELISA-test.

Lactating cows in 19 herds were tested for antibodies at 4 annual herd tests (in 2003-2005). The cows were classified into 6 categories: 0) Repeatedly negative (min. 2 x); 1) Negative, but only 1 test available; 2) Last test positive, but previous tests negative; 3) Potentially false-positives (last 4 tests negative, but previously one positive result); 4) Fluctuating (interchangeable positive and negative); 5) repeatedly positive.

Energy-corrected milk (ECM) yield for each of the cows were estimated based on the milk recordings obtained from 11 samples per cow per year. The expected cumulative 305-day kg ECM was estimated for cows in each of the six groups and compared to group 0. The analyses suggest that cows of groups 2 and 9 have production losses of 10-12%, irrespective of parity. Cows of groups 3 and 5 did not experience significant production losses. The summarised production loss was not consistent with the farmers' perception of "a problem".

Introduction

Paratuberculosis is a chronic infection, which can cause milk production losses of dairy cattle. A slow and variable incubation period requires continuous monitoring to predict which cows have a lower milk production than expected as a sequel to infection with *Mycobacterium avium* subsp. *paratuberculosis*. A milk ELISA is sufficiently cheap to allow repeated testing of individual milking cows. However, an evaluation of the test-results relative to production losses are required for appropriate decision making based on the patterns of the test-results.

The objective of our study was to estimate production losses associated with MAP in 6 groups of dairy cows that were classified based on their pattern of ELISA-reactions.

Materials and Methods

Nineteen herds were selected for an intervention study for paratuberculosis and *Salmonella* Dublin. The herds were selected by the practising veterinarian of the herd based on the following criteria: They

should be interested in paratuberculosis or *Salmonella* Dublin, but their herd should not necessarily be an infected herd. The primary objective with this selection was to retain the herds in the project for a 3-year period and to operate with motivated farmers. The study population is thus not representative of Danish farmers. In 7 herds, the farmer and veterinarian did not think MAP was present. MAP has subsequently been cultured repeatedly from 5 of the herds (Green Group). In 6 farms, the farmer knew MAP was present but did not consider it a problem (Yellow Group). In 6 herds, the farmer knew MAP was present and thought of it as a problem (Red Group). Two herds ceased production during the study period, both from the Red group, but production records obtained were used in the study.

Milk samples were collected 4 times per year per herd during a 3 year period and each sample was assessed for presence of antibodies with an ELISA. Cows were grouped into 6 paratuberculosis (PTB) groups: 0) Repeatedly ELISA-negative; 1) one sample only and that sample was negative; 2) positive in last sample obtained; 3) more than 4 samples, where the last 3 were negative but a positive sample had previously occurred; 4) at least 2 positive samples but the last sample was negative, and 5) last 2 samples positive. Milk production data were collected via the milk recording scheme where samples were collected 11 times per year.

Cows were divided into 3 parity groups: 1st parity, 2nd parity and later. For each parity group, a hockey-stick model was fitted as lactation curves, similar to the model described in Nielsen et al. (2002). The model also included a variable with the 6 PTB groups.

This test-day model was then used to estimate the predicted cumulative 305 kg energy corrected milk (kg ECM) yield for the PTB groups. The number of cows in each PTB group combined with the predicted loss for each PTB group was subsequently summarised for each herd.

Results

The 3617 cows were distributed in the 6 PTB groups as follows: Group 0: 2056 cows; Group 1: 687 cows; Group 2: 203 cows; Group 3: 177 cows; Group 4: 229 cows; Group 5: 265 cows. There was no statistically significant difference between kg ECM milk of Groups 1, 3 and 4 relative to Group 0 in either parity. First parity cows of Group 2 yielded 1072 kg ECM (12.6%) less milk than the Group 0 cows. First parity cows of Group 5 yielded 1046 kg ECM (12.3%) less milk than the Group 0. For 2nd parity cows, Group 2 yielded 1126 kg (11%) ECM less than Group 0 cows, and Group 5 yielded 1035 kg. (10%) ECM less. For >2nd parity, the figures for Group 2 and Group 5 were 1401 kg ECM (14%) and 698 kg ECM (7%) less, respectively. The figures mentioned were for Danish Holsteins. Slightly different, but comparable, figures were estimated for Danish Jerseys (data not shown).

The milk production losses for each herd are summarised in Table 1, taking into account the breed and parity distribution in the herd. As expected, there was a difference in average loss per herd depending on the prevalence. However, there was a huge difference between the three groups of red, yellow and green herds, indicating that farmers' perception of a problem may not be related to the summarised production loss.

Table 1. Reduced milk production attributable to infection with *Mycobacterium avium* subsp. *paratuberculosis* (MAP) in 19 non-random Danish dairy herds

Problem in herd[#]	Herd ID	No. of lactations		Lactations with reduced production and MAP[§]	Total loss in herd (kg ECM)	Average loss (kg ECM) /lactation evaluated
		Evaluated[¤]	With reduced production and MAP[§]			
Green	2	185	8	4%	7347	40
Green	1	73	3	4%	3657	50
Green	4	157	15	10%	15052	103
Green	7	152	20	13%	21608	142
Green	15	151	43	28%	40412	268
Green	16	80	22	28%	23585	295
Green	18	85	35	41%	40862	481
Yellow	5	173	17	10%	17578	102
Yellow	6	112	12	11%	12740	114
Yellow	10	135	22	16%	21435	159
Yellow	11	165	27	16%	26659	162
Yellow	14	264	56	21%	52326	198
Yellow	17	112	45	40%	37523	335
Red	3	261	19	7%	18149	70
Red	8	151	24	16%	21044	139
Red	12	284	53	19%	45247	159
Red	9	148	24	16%	25744	174
Red	13	183	35	19%	34755	190
Red	19	154	72	47%	79789	518
	Total	3025	552	18%	545513	180

[§]MAP cows with production losses were cows with: a) repeated high levels of antibodies, or b) last test-result was positive in antibody test. Cows without production losses were cows which were: i) repeatedly negative in antibody test; ii) negative at last antibody testing but with previous positive test results. Cows with only one negative test-result are not included in the summary. Danish Holsteins with production losses produced, on average, 12.5% less in 1st parity; 11% less in 2nd parity and 10.5% less in 3rd and higher parities, relative to cows without production losses. For Jerseys, the losses were slightly different.

¤ Cows of Groups 1 and 3 are omitted from this summary.

Problem in herd: Green: Farmer thought MAP was not present; Yellow: Farmer thought MAP was present but did not consider it a problem; Red: Farmer thought MAP was present as a problem

Discussion

Paratuberculosis is known to cause production losses in dairy cattle but the magnitude is often not expressed for specific herds in the process of intervening against the infection in a specific herd. This may be due to lack of diagnostic information. The suggested method based on repeated screening using a milk antibody ELISA can be useful for visualising production losses. This information can be used to promote interest for intervention against the infection. The magnitude of total milk loss may differ from one herd to another, but the losses shown in Table 1 do not correlate well with the farmers' perception of the problem. For advisors and decision makers, the numbers obtained could be useful in the long-term process of intervention against paratuberculosis.

References

Nielsen, S.S., Enevoldsen, C., Gröhn, Y.T. (2002). The *Mycobacterium avium* subsp. *paratuberculosis* ELISA response by parity and stage of lactation. Prev Vet Med, 54, 1-10.