Effects of postpartum treatment with non-steroidal anti-inflammatory drugs on milk production and culling risk in dairy cattle

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Effects of postpartum treatment with non-steroidal anti-inflammatory drugs on milk production and culling risk in dairy cattle

Abstract

Inflammation during early lactation is common in dairy cattle, and a high degree of inflammation during this time has recently been associated with both lower productivity and greater risk of disease during that lactation. Early lactation treatments with two non-steroidal anti-inflammatory drugs were compared with a placebo treatment to evaluate effects on whole-lactation productivity and retention in the herd. Both meloxicam and sodium salicylate increased whole-lactation milk and milk protein yields by 6 to 9%, despite being administered for only 1 or 3 days in early lactation, respectively. In addition, meloxicam treatment tended to decrease the risk of cows leaving the herd during the lactation. These results indicate that postpartum inflammatory signals have long-lasting effects on lactation in dairy cattle.; Dairy Day, 2014, Kansas State University, Manhattan, KS, 2014; Dairy Research, 2014 is known as Dairy Day, 2014

Keywords

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Effects of Postpartum Treatment with Non-Steroidal Anti-Inflammatory Drugs on Milk Production and Culling Risk in Dairy Cattle

A. Carpenter, C. Ylioja, C. Vargas, L. Mamedova, L. Mendonça, J. Coetzee[1], L. Hollis, R. Gehring, B. Bradford

Summary

Inflammation during early lactation is common in dairy cattle, and a high degree of inflammation during this time has recently been associated with both lower productivity and greater risk of disease during that lactation. Early lactation treatments with two non-steroidal anti-inflammatory drugs were compared with a placebo treatment to evaluate effects on whole-lactation productivity and retention in the herd. Both meloxicam and sodium salicylate increased whole-lactation milk and milk protein yields by 6 to 9%, despite being administered for only 1 or 3 days in early lactation, respectively. In addition, meloxicam treatment tended to decrease the risk of cows leaving the herd during the lactation. These results indicate that postpartum inflammatory signals have long-lasting effects on lactation in dairy cattle.

Key words: transition dairy cow, inflammation, non-steroidal anti-inflammatory drug

Introduction

A growing body of research indicates that systemic metabolic inflammation is elevated in dairy cows at parturition and that this inflammation may play a role in the development of metabolic disorders during the transition period. Furthermore, inflammation has been linked to negative production outcomes. In one study, authors reported that cows in the highest quartile of inflammation had decreased milk production compared with their counterparts (30.9 kg/day vs. 24.4 kg/day in cows with low inflammation). In previous work at Kansas State, we administered dairy cattle with the non-steroidal anti-inflammatory drug (NSAID) sodium salicylate (SS) via drinking water in the week following calving in an attempt to prevent inflammation. Despite the fact that transition disorders were rare in either group, treatment with SS was associated with elevated whole-lactation milk production in older cows. Cows in their third or later lactation that received SS produced 21% more milk over a 305-day lactation.

Meloxicam is another drug in the NSAID class. Previous research in lactating cattle has focused on its use during clinical mastitis or following assisted calving, but meloxicam's effects on milk production in normal postpartum dairy cattle have not yet been investigated. Considering the effects of SS on production, it is likely that meloxicam may also have beneficial effects on lactation. Therefore, the objective of this study was to determine if SS or meloxicam would have similar effects on whole-lactation productivity of dairy cows on a commercial dairy farm.

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Experimental Procedures

Multiparous cows (n = 51 per treatment) from a commercial dairy were enrolled in the study 12 to 36 hours after calving. Cows receiving SS treatment (SS) received a placebo bolus on day 1 of treatment and an oral drench containing 125/g/day of SS in 375 mL of water for 3 consecutive days beginning on day 1 of treatment. Meloxicam-treated cows (M) received 675 mg of meloxicam as a bolus on day 1 of treatment in combination with 3 consecutive daily drenches of 375 mL of water. Control animals (CON) received a placebo bolus on day 1 and water drenches. Treatments were blocked by mastitis at parturition (CON = 1, M = 2, SS = 2), breed (CON = 6, M = 6, SS = 4 crossbreds; all other cows were Holsteins), dystocia (CON = 5, M = 5, SS = 6), and twin births (CON = 4, M = 4, SS = 3). Dystocia was defined as a calving difficulty score of 3 or greater.

Whole-lactation milk yield data were analyzed with a covariate of predicted transmitting ability for milk production, the fixed effects of block, parity, treatment, week, and treatment × week interaction, and the random effect of cow. The model accounted for repeated measures over time with an autoregressive covariance structure. Treatment contrasts were evaluated using the Tukey test with significance declared at $P < 0.05$. Removal rate from the herd and pregnancy rate were evaluated by Cox regression proportional hazard analysis, and disease incidences were tested by Fisher's exact test.

Results

Milk production responses to treatment were evaluated using two different data sources. Adjusted 305-day mature equivalent yields of milk, fat, and protein through DHIA testing revealed significant whole-lactation milk and protein responses to both M and SS treatments, representing 6 to 9% advantages for the NSAID treatments (Table 1). Numerical differences in fat yield were of similar magnitude (5 to 6%) but were not statistically significant. In addition, daily milk yield data from the farm management system were analyzed to assess treatment responses over time. The overall treatment effect on daily milk production was again significant for both NSAID treatments ($P < 0.05$, Figure 1), with a slightly larger mean response of 10 to 12%. As we observed in a previous study with SS, milk yields did not diverge until the second month of lactation, but differences in productivity then remained through the end of lactation. Despite the increase in productivity, body condition score monitoring throughout lactation revealed no differences between treatments (Table 1).

Treatments did not alter pregnancy rate on first service (mean: 23%) and had no impact on risk of pregnancy throughout the lactation. However, analysis of retention within the herd did reveal a tendency for M to improve retention compared with CON ($P = 0.06$), with SS intermediate (Figure 2). By the end of the lactation, 41% of CON cows had left the herd, compared with 31% for SS and only 25% for M. The only culling reason that differed between M and C was the code "other disease," which accounted for 8 culls in CON and only 2 in M ($P = 0.09$); this code was used for a variety of conditions, including key transition problems such as ketosis and respiratory disease.

Discussion

These results represent the fourth study demonstrating that short-term early lactation treatment with SS can enhance peak milk yield and the first to demonstrate similar re-

sults with M. More importantly, this study is the first such finding with a relatively large sample size and with daily milk yield data to allow for accurate analysis of the lactation curve following treatment.

The fact that early lactation treatment (for as little as 1 day) with an anti-inflammatory agent can influence milk production for at least 10 months is fascinating and is not easily explainable. Our group is currently conducting research to explore the possibility that interrupting early lactation inflammation programs the mammary gland to allow for increased expression of milk synthesis genes as lactation proceeds.

Equally exciting is the possibility that M treatment can improve health in early lactation to limit the culling rate. Our sample size for this outcome was minimal, however, and our findings, which were of marginal significance, should be considered preliminary. In previous work, we carefully evaluated the effects of SS on metabolic health and found no evidence of improvement, but the current results seem to hint at a different response to M treatment, particularly in the critical first 60 days of lactation. Larger studies should help clarify whether these findings are meaningful or not.

Conclusions

Both M and SS increased 305-day milk and protein yields compared with CON with no effect on 305-day milk fat. These responses were primarily due to increased peak milk yield and sustained differences through late lactation and did not appear until the second month of lactation. Furthermore, neither treatment affected body condition score, and M tended to improve retention in the herd compared with CON. The long-term benefits of early lactation NSAID use are surprising and will require further research to understand the underlying mechanisms. Although using these approaches commercially is not currently legal, ongoing research may allow for nutritional or pharmaceutical approaches to take advantage of these findings in the future.

Table 1. Whole-lactation (305-day) mature equivalent milk yield and body condition score (BCS) responses to early lactation treatment with anti-inflammatory drugs

Item	Treatment			SE	P-value
	CON	Meloxicam	Sodium salicylate		
Milk yield (lb)	23,091[b]	24,707[a]	25,161[a]	1,072	0.02
Fat yield (lb)	869	919	913	40	0.13
Protein yield (lb)	739[b]	785[a]	789[a]	31	0.03
BCS[1]	3.24	3.30	3.20	0.12	0.52

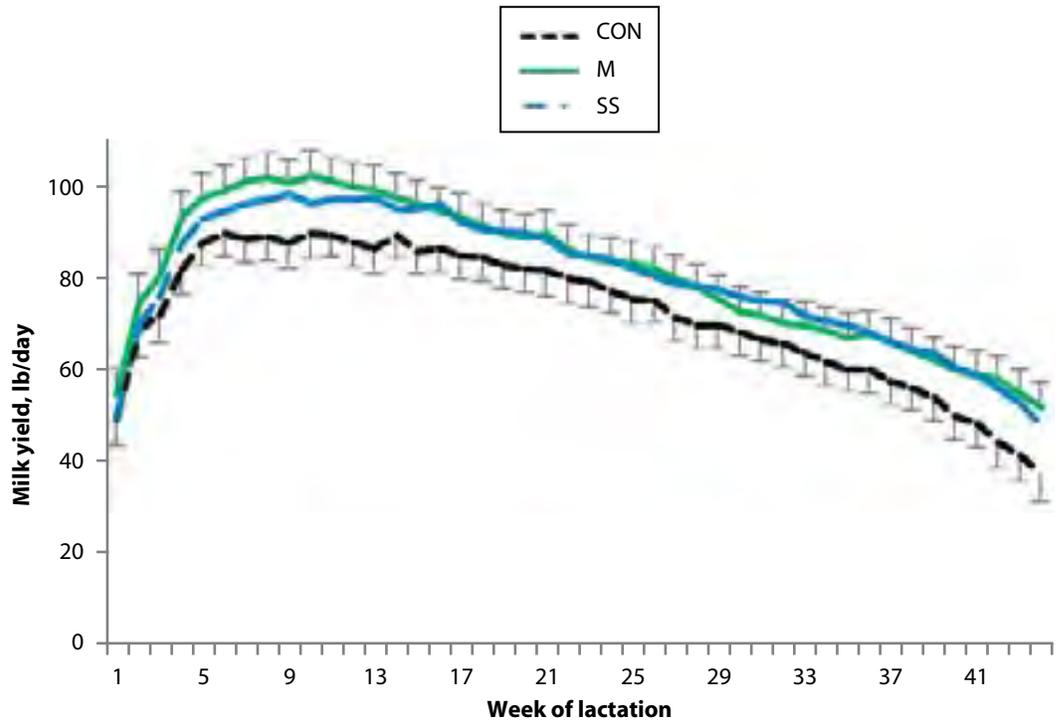[1] 1 to 5 scale; 1 = thin and 5 = fat.

Figure 1. Whole-lactation milk yield responses to early lactation treatments. Daily milk yield data were summarized by week and evaluated for the entire 44-week lactation. Both meloxicam (M) and sodium salicylate (SS) significantly increased daily milk yield by an average of 8.7 and 7.5 lb/day, respectively ($P < 0.05$), compared with the control. Treatment differences were not significant until week 7 of lactation, then remained significant or marginally significant ($P < 0.10$) for most weeks through the end of lactation.
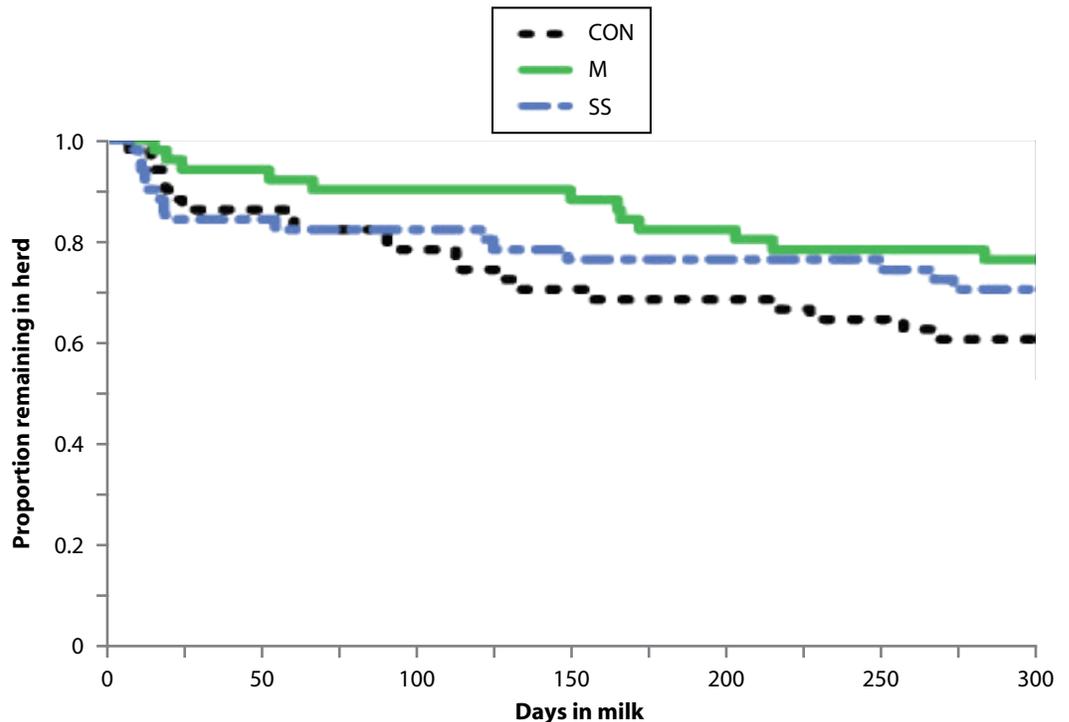

Figure 2. Survival analysis of retention in the herd after early lactation treatments. Meloxicam (M) treatment tended to increase retention in the herd compared with the control (CON), as assessed by the Wilcoxon Chi-squared test ($P = 0.06$). Sodium salicylate (SS) did not differ from other treatments.