Effects of Sodium Salicylate on Productivity of Postpartum Dairy Cows

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Summary

Inflammation has been proposed as a contributor to metabolic disorders in transition dairy cows. The purpose of this experiment was to determine whether a non-steroidal anti-inflammatory drug, sodium salicylate (**SS**), benefits transition cows. At calving, 78 cows (primiparous, n = 39; second lactation, n = 28; ≥3 lactations, n = 11) were assigned alternately to either a control (**CON**) or SS treatment for 7 days and remained on study until 21 days postpartum. Treatment was administered via individual water bowls at a concentration of 2.5 g/L, delivering a mean of 183 ± 8.5 g/day SS during the 7 days of treatment. Milk yields were collected daily and milk samples were collected twice weekly. Data were analyzed using mixed models with repeated measures over time. No treatment effects were detected for daily feed or water intake. Milk yield for third or greater lactation cows tended to increase ($P < 0.10$) with SS at the end of the trial (days 19 to 20). Milk protein content increased ($P < 0.05$) with SS in first- and second-lactation cows during week 1 and milk urea nitrogen (**MUN**) decreased ($P < 0.01$) with SS. Milk fat content increased ($P < 0.05$) with SS in weeks 2 and 3 postpartum. A 10% increase ($P < 0.05$) in energy-corrected milk (**ECM**) was observed for SS cows during week 3. Metritis incidence increased ($P < 0.01$) with SS in third or greater lactation cows, but no other effects on disease incidence were detected. In contrast to our hypothesis that SS treatment would decrease transition disorder incidences, SS treatment seemed to promote increased milk fat content and milk energy output during early lactation with no effect on total disorder incidence.

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

Introduction

The transition period is a time of metabolic problems for dairy cattle, and these problems cause substantial costs for producers. A majority of the metabolic issues stem from the negative energy balance associated with the increase in nutrients needed for the mammary gland. In addition to negative energy balance contributing to transition disorders, inflammation has been hypothesized to play a role. Specifically, one study utilizing 3 commercial Italian dairies showed that cows exhibiting the strongest inflammatory profiles were 8 times more likely to experience transitional disorders, had lower plasma calcium concentrations, took longer to re-breed, and produced less milk during the first month of lactation. Another study at Kansas State University showed a disruption in normal metabolism in dairy cows subject to a low-level, short-term induced inflammation. These findings support the hypothesis that inflammation is a contributing factor to transition disorders.

Non-steroidal anti-inflammatory drugs (**NSAIDs**) are used to combat the effects of inflammation (i.e., pain, redness, and swelling). These types of drugs have been used in dairy research as a component of treatment protocols for bacterial infections (primarily mastitis); however, a few NSAIDs have been used to treat metabolic disorders. The purpose of this experiment was to determine if an oral dose of sodium salicylate (**SS**) during the first 7 days after calving can minimize transition disorders while maintaining milk production.

Experimental Procedures

Seventy-eight Holstein cows (primiparous, n = 39; second lactation, n = 28; ≥3 lactations, n = 11) from the Kansas State University Dairy Research Center were enrolled in the experiment. Cows were assigned alternately to either of 2 treatments on the day of parturition. Cows that had lameness issues or milk fever were not enrolled in the experiment. Treatments were balanced among parities and consisted of 7-day CON or SS treatments administered through individual water bowls. Cows were housed in a tie-stall facility, fed ad libitum at 6:00 a.m. and 6:00 p.m., and milked thrice daily (2:00 a.m., 10:00 a.m., and 6:00 p.m.). Sodium salicylate in a molasses carrier was administered at 2.5 g/L and the CON cows received the same concentration of molasses in the water as the SS cows during the treatment period. On the eighth day after calving, all cows were placed on regular water during the remainder of the experiment. The cows were monitored daily for signs of illness, feed intake, and water intake. Milk yield was recorded during the entire 21 days and milk samples were collected and milk components were measured twice weekly. Body condition score (**BCS**; 1= thin and 5=fat) was evaluated by three trained personnel on days 1, 7, 14, and 21. All common disorders were diagnosed according to clearly established criteria. Data were analyzed using mixed models with repeated measures over time. Traits of interest included treatment, parity, time (week or day as the unit measure of time), and interactions of treatment with time and parity.

Results and Discussion

No treatment effects were detected for daily feed or water intake. Water and feed intake followed the same pattern as milk production, increasing during the 3-week experiment. All feed and water intakes were similar to our predicted values, indicating that our treatment did not negatively affect an already stressed transition dairy cow.

Treatment did not affect milk yield; however, older cows (second lactation and greater) produced ($P < 0.001$) more milk than first-lactation cows. In addition, a treatment by parity by day effect for milk yield was detected where third-lactation and older cows treated with SS tended ($P < 0.10$) to produce more milk on days 19 to 20 (Figure 1). Furthermore, a 10% increase in ECM was detected ($P < 0.05$) for SS cows during week 3 (Figure 2). As expected, third-lactation and older cows produced the most ($P < 0.05$) ECM, with first-lactation cows the smallest and second-lactation cows intermediate. Milk protein content was increased ($P < 0.05$) by SS treatment in first and second-lactation cows during week 1, and this effect held true for first-lactation cows through weeks 2 and 3. Milk urea nitrogen (**MUN**) was decreased ($P < 0.05$) by SS treatment (12.9 vs. 11.5 ± 0.4 mg/dL). Milk fat was increased ($P < 0.05$) by SS treatment during weeks 2 and 3 (Figure 3). Milk fat content also decreased ($P < 0.01$) over the 3-week period. No treatment effects were observed for milk lactose content or somatic cell count.

Metritis incidence was increased ($P < 0.01$) by SS in third-lactation and older cows, but no other effects on diseases were detected (Table 1). The incidence of metritis should be carefully interpreted because of the small number of cows in this treatment (n = 11). A greater number of control cows had to be treated during the first week of the experiment, whereas more SS cows showed their first signs of a disorder during the second week of the experiment (Figure 4).

The milk results from this study are similar to those in another study conducted in Italy in which researchers gave transition dairy cows daily injections of aspirin for 5 days postpartum. The authors observed an improved milk yield during the first 2 months of lactation and increased first-service conception rates. The Italian group observed an apparent increase in me-

tritis incidence (30.4% aspirin-treated vs. 13.6% control), but a decrease in ketosis incidence (4.4 vs. 22.7%). In contrast, we did not detect any overall differences in disease incidence in our study using a different NSAID administered orally. Nevertheless, the increase in mastitis in older cows treated with SS is at least consistent with the negative effects reported by the Italian group. In general, caution is warranted in the use of NSAID therapy in transition cows; 2 recent studies also reported increased risk of metritis and decreased feed intake when transition cows were treated with flunixin.

Sodium salicylate seems to alter some metabolic pathways leading to measurable changes in the transition dairy cow. The exact pathways that are affected are still being investigated, but given that SS has potent anti-inflammatory effects, at least some of the metabolic responses to SS are likely mediated by decreases in inflammatory signals. These results, then, suggest that the effects of inflammation on the transition dairy cow warrant further exploration.

Table 1. Disorder occurrences

Disorder	Incidence (%)[1]	CON (n)[2]	SS (n)[3]	*P*-value[4]
Ketosis	32.1	12	13	NS
Lameness	5.1	3	1	NS
Temperature[5]	28.2	11	11	NS
Metritis	23.1	8	10	NS[8]
Displaced abomasum	7.7	2	4	NS
Diarrhea	7.7	4	2	NS
Retained placenta	10.3	4	4	NS
Mastitis	19.2	7	8	NS
Other[6]	11.5	4	6	NS
Multiple[7]	44.9	16	19	NS

[1] Total diagnosed and treated incidence of each specific disorder out of all 78 cows.
[2] Count of control cows diagnosed with the specific disorder.
[3] Count of salicylate treated cows diagnosed with the specific disorder.
[4] Not significant ($P > 0.10$).
[5] Cows had a fever >104°F but no other symptoms.
[6] Cows that were diagnosed with something other than that listed above (i.e., hardware disease).
[7] Cows that were diagnosed and treated as having more than one disorder during the trial.
[8] Third-parity cows were the only cows that showed a significant increase ($P < 0.05$).

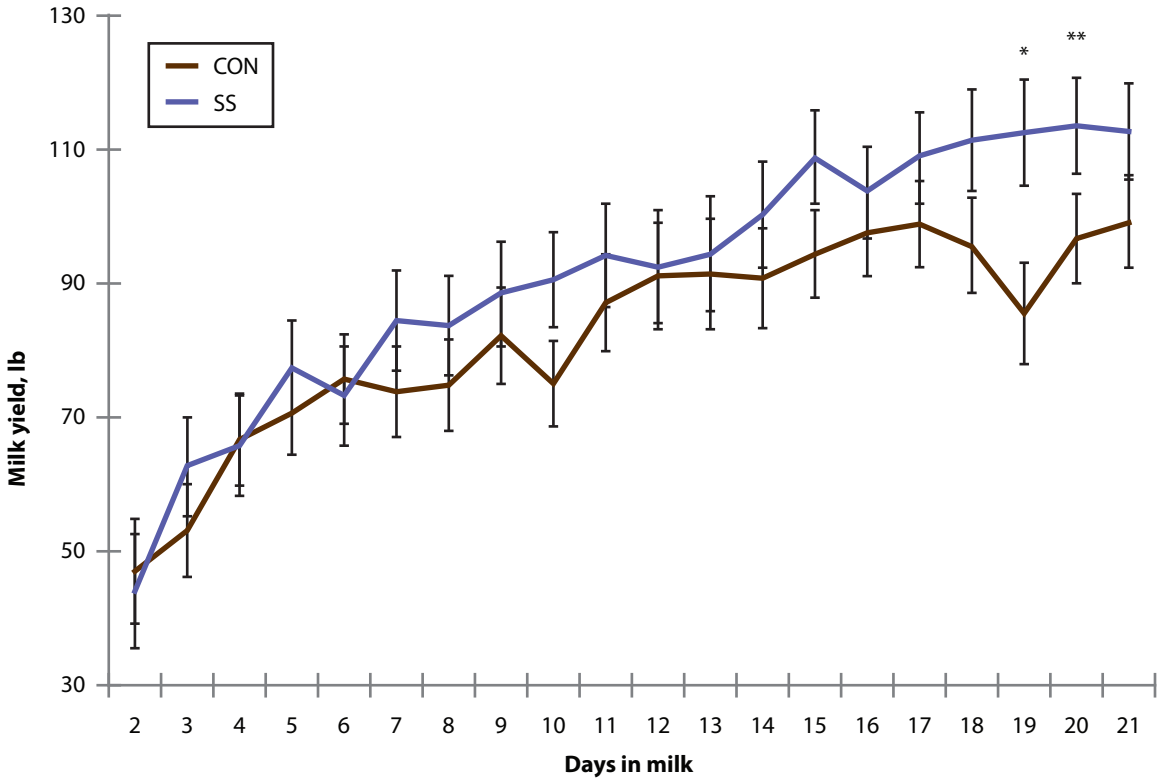

Figure 1. Milk yield for third-lactation or greater cows (n = 11) shows a treatment by parity by time interaction ($P < 0.05$) for milk yield in which sodium salicylate (SS)-treated cows had greater milk yield than the control (CON) on day 19 and tended to be greater on day 20.* $P < 0.05$; ** $P < 0.10$.

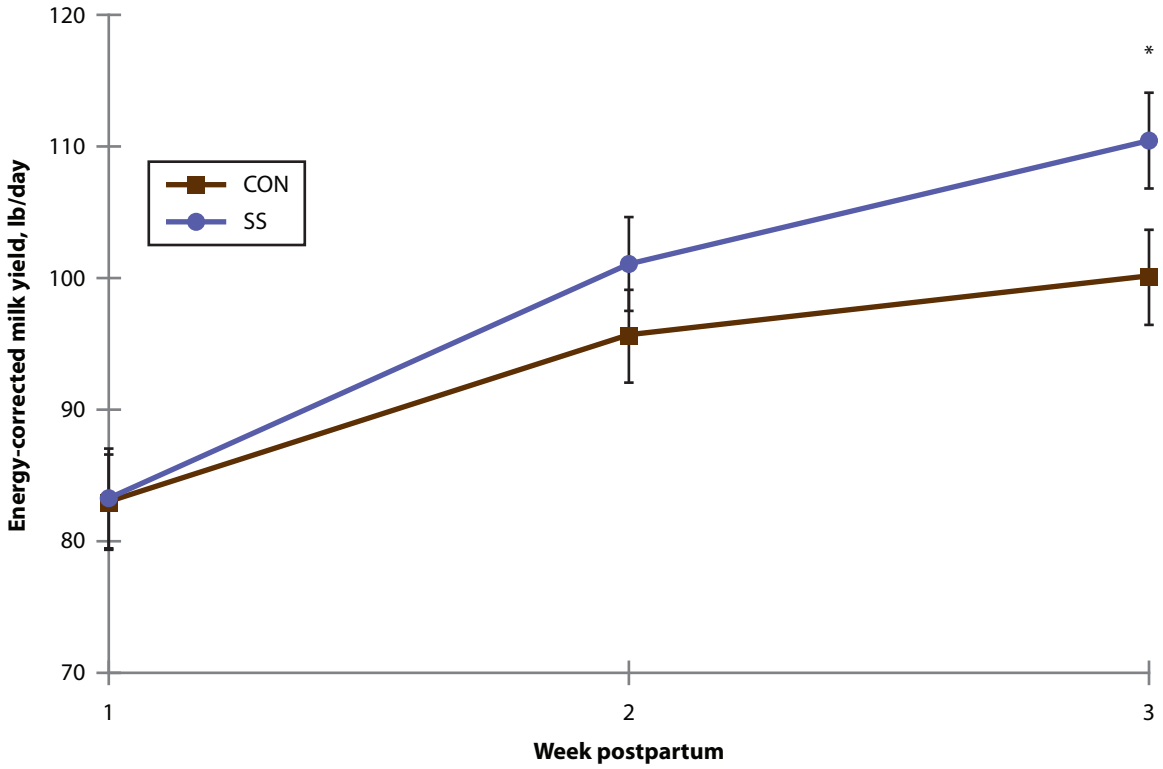

Figure 2. Energy-corrected milk yield shows a treatment by week interaction ($P = 0.11$) with a clear increase ($P < 0.05$) during week 3 for sodium salicylate (SS)-treated cows compared with the control (CON). * $P < 0.05$.

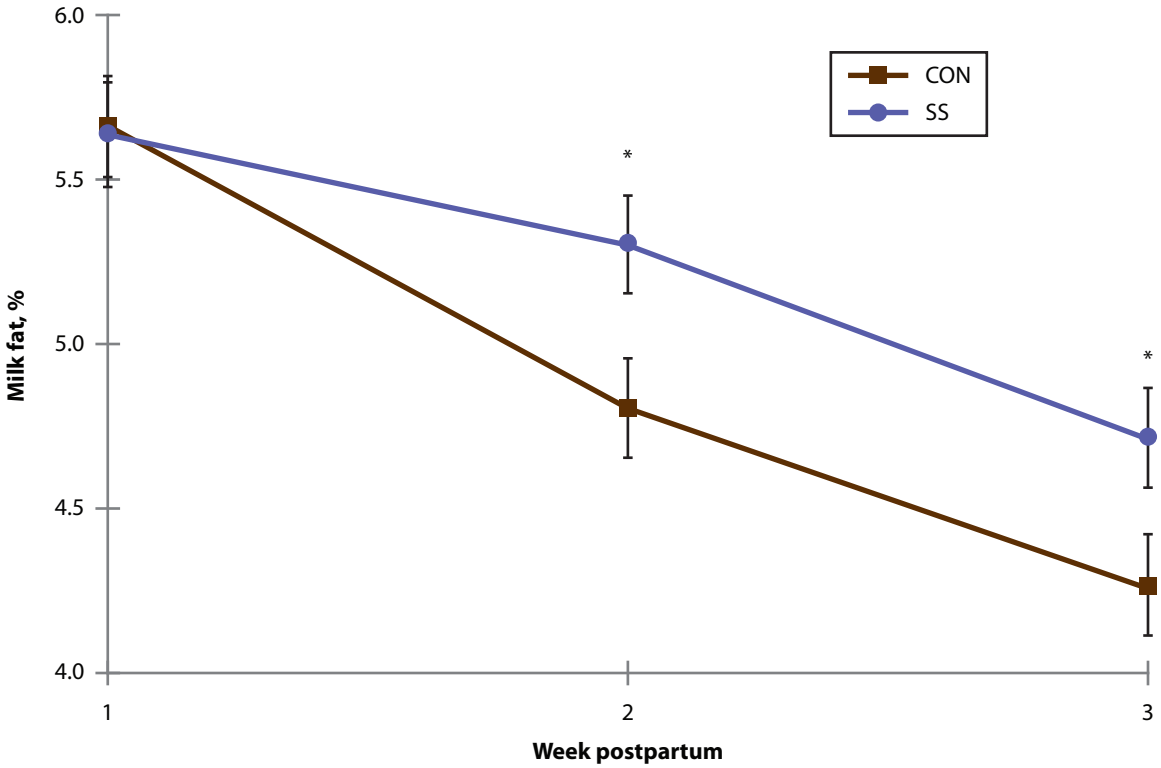

Figure 3. Milk fat percentage by week shows that milk fat was greater ($P < 0.05$) for sodium salicylate (SS)-treated cows than the control (CON) during weeks 2 and 3.* $P < 0.05$.

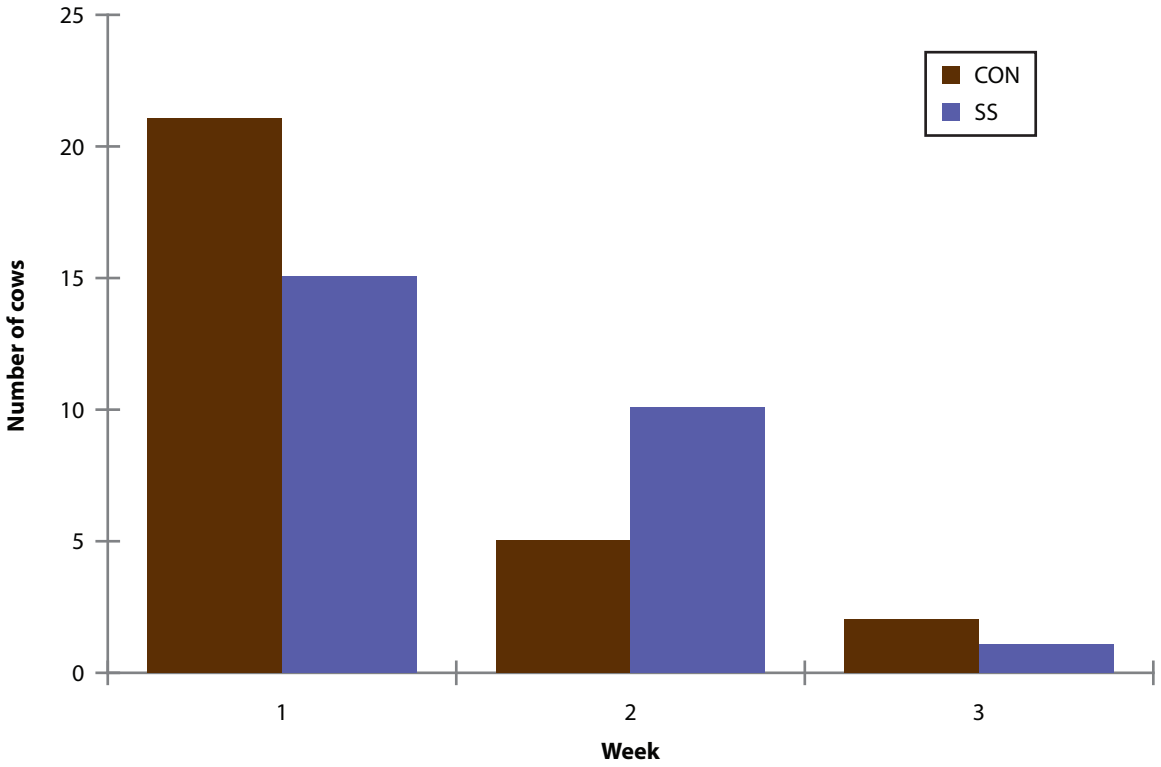

Figure 4. Distribution of cows with diagnosed disorders for treated (SS) and control (CON) cows.