J. Dairy Sci. 101:1–11
https://doi.org/10.3168/jds.2017-13057

Effects of early postpartum sodium salicylate treatment on long-term milk, intake, and blood parameters of dairy cows

A. J. Carpenter,[1] C. M. Ylioja, L. K. Mamedova, K. E. Olagaray, and B. J. Bradford[2]
Department of Animal Sciences and Industry, Kansas State University, Manhattan 66506

ABSTRACT

Previous research has shown that cows who receive treatment with nonsteroidal anti-inflammatory drugs after calving may have increased milk yield beginning near peak lactation, resulting in greater 305-d milk production. It has not been demonstrated whether this response is associated with greater feed intake following the first 3 wk of lactation. Dry matter intake (DMI) and milk yield were measured daily for 56 cows over the first 120 d in milk. Cows in their second parity and greater were blocked by parity and alternately enrolled 12 to 36 h after calving into 1 of 2 treatments: either 3 daily drenches of water or 3 daily drenches of a similar volume of water containing 125 g of sodium salicylate (SAL) beginning 12 to 36 h after calving. Cows were housed in individual stalls to monitor DMI. Blood samples were collected before calving and on the last day of treatment, as well as at 7, 11, 14, 18, 21, 35, 49, 63, 77, 91, 105, and 120 d in milk. The SAL treatment did not affect estimated 305-d milk, fat, or protein yields (from monthly test days), daily milk yield or components, energy-corrected milk, fat-corrected milk, or DMI; however, an interaction between parity and treatment was observed for DMI, where second-parity SAL cows had decreased intake with no differences observed in older cows. This resulted in a parity by treatment interaction for the ratio of energy-corrected milk to DMI. Similarly, no main effects of treatment were observed for plasma glucose, β-hydroxybutyrate (BHB), or fatty acid concentrations, but we noted interactions between treatment and parity for glucose, BHB, and insulin. Older cows had greater plasma glucose and insulin concentrations and decreased plasma BHB following SAL but no differences were observed in second parity animals. Alterations in glucose and insulin resulted in a tendency for a treatment by time interaction for the revised quantitative insulin sensitivity check index. Feeding behavior was also altered following SAL administration, resulting in fewer but longer meals, as well as a tendency for greater meal weight. A tendency for a treatment by week interaction for inter-meal interval was observed, as well as a parity by treatment interaction for meal weight. Despite the lack of a milk yield response, SAL had a prolonged programming effect on feeding behavior and blood variables over the first 120 DIM, with responses largely dependent on parity.

Key words: inflammation, feeding behavior, nonsteroidal anti-inflammatory drug, metabolism, dairy cow

INTRODUCTION

The transition period—defined as 3 wk before and 3 wk following parturition in dairy cattle—is notorious for its potential pitfalls and challenges to dairy farm management. In addition to the event of parturition itself, milk production requires an enormous amount of energy, resulting in a vast shift in metabolism (Bell, 1995). As a result of numerous metabolic, dietary, and social pressures, early-lactation dairy cattle are prone to a plethora of metabolic disorders. Metritis, retained placenta, and excessive negative energy balance (Staples et al., 1990) can lead to reproductive failures in the ensuing lactation; therefore, a successful lactation is dependent on a successful transition period.

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 (Bradford et al., 2015). Furthermore, inflammation has been linked to negative production outcomes (Bionaz et al., 2007; Bertoni et al., 2008; Yuan et al., 2013); however, it is not fully understood what role inflammation plays in the early-lactation dairy cow.

Farney et al. (2013b) demonstrated that postpartum administration of the nonsteroidal anti-inflammatory drug (**NSAID**) sodium salicylate (**SS**) administered in the drinking water for the first 7 d after calving

Received April 20, 2017.
Accepted October 8, 2017.
[1]Current affiliation: Department of Animal Biosciences, University of Guelph, Ridgetown, ON, Canada N0P 2C0.
[2]Corresponding author: bbradfor@ksu.edu

increased 305-d milk production. Similarly, Carpenter et al. (2016) showed that short-term NSAID treatment (3 daily drenches of SS or 1 meloxicam bolus) increased weekly milk yields beginning at 7 wk in lactation, ultimately resulting in increased 305-d milk yield. Interestingly, Farney et al. (2013b) did not detect a difference in milk production during the first 21 d of milk production, and Carpenter et al. (2016) demonstrated that elevated milk production due to NSAID treatment did not occur until 7 wk in milk, with a tendency for treatment effects by 4 wk. Thus, the fact that Farney et al. (2013b) did not detect a difference in feed intake in the 2 wk following SS administration is not surprising, as the milk production response was delayed. Carpenter et al. (2016) performed their experiment on a commercial dairy without measurement of DMI, so it is unknown whether feed intake was also affected by NSAID treatment and to what extent.

The overall aim of our experiment was to determine whether long-term milk production response to early-lactation treatment with SS is achieved through effects on metabolic efficiency, DMI, or both. To address these questions, our objectives were to monitor milk production, feed intake, feeding behavior, production efficiency, and blood parameters for 120 d in dairy cows who received SS or placebo treatment following calving.

MATERIALS AND METHODS

Animals and Treatments

All experimental procedures were approved by the Kansas State University Institutional Animal Care and Use Committee. Holstein cows (n = 28/treatment) entering at least their second lactation were enrolled on this study between January 24, 2014, and December 24, 2014. Farney et al. (2013b) demonstrated that SS tended to decrease 305-d milk production in primiparous cows, so they were not enrolled in the current study. A total of 40 cows were in their second parity, whereas 16 cows were in their third parity and greater. Cows were blocked according to parity and sequentially assigned to either SS drench (**SAL**) or water drench (**CON**) at calving. Treatment drenches were given according to the procedure of Carpenter et al. (2016). In short, oral drenches were given once daily for 3 consecutive days between 1400 and 1600 h, beginning 12 to 36 h after parturition. Cows assigned to SAL received 125 g/d of SS dissolved in approximately 375 mL of water, whereas CON animals received an equal volume of water without SS.

All animals were housed at the tiestall facility at the Kansas State University Dairy Teaching and Research Center from calving to 120 DIM. Cows were fed twice daily (0630 and 1730 h) at 110% of expected intake and milked 3 times daily (0000, 1000, and 1700 h); milk weights were recorded at each milking. A total of 4 cows, all in their second parity, were excluded from the study due to injury or health events. Of these, 2 were suspected to have ruptured colonic ulcers (n = 1/treatment) and 2 experienced injury (n = 1/treatment). In total, 52 cows remained on study for the full 120 d.

Sampling and Analysis

Feed delivered and refused were measured daily to determine feed intake for all cows. Samples of TMR were collected weekly and stored at −20°C, then composited in 2-mo intervals and analyzed for chemical composition with near infrared reflectance spectroscopy by Dairy One (Ithaca, NY). Ingredient and chemical composition of the ration is presented in Table 1. For all cows of parity 3+ and 26 second-parity cows, feeding behavior was measured via feed bunks suspended from load cells for continuous monitoring of bunk weight. Feeding behavior variables (meal weight, meal length, number of meals/day, and intermeal interval) were determined as described by Yuan et al. (2015).

Blood samples were collected via the coccygeal vein on the first and last day of treatment (3 DIM), as well as d 7, 11, 14, 18, 21, 35, 49, 63, 77, 91, 105, and 120 following calving, before the morning feeding. Two tubes (approximately 7 mL each) were used for each blood sample time point; one tube contained potassium EDTA and the other contained potassium oxalate with sodium fluoride as a glycolytic inhibitor (Vacutainer; Becton, Dickinson and Co., Franklin Lakes, NJ). Plas-

Table 1. Average composition of diet fed to cows up to 120 DIM[1]

Item	% of diet DM	Mean	SD
Alfalfa hay	19.6		
Corn silage	20.9		
Wet corn gluten feed[2]	29.3		
Cottonseed	3.8		
Fine rolled corn	15.9		
Expeller soybean meal[3]	4.9		
Straw	1.5		
Vitamin and mineral mix	4.3		
DM (% as fed)		51.2	1.59
CP (% of DM)		17.8	0.55
ADF (% of DM)		21.2	1.30
NDF (% of DM)		33.2	1.57
Ether extract (% of DM)		4.8	0.36
NE_L (Mcal/kg of DM)		1.67	0.027

[1]Samples of TMR were collected once per week throughout the experiment and pooled into 2-mo intervals for analysis. Means and SD of all values across time are reported. NE_L estimated according to NRC (2001).

[2]Sweet Bran; Cargill Inc., Blair, NE.

[3]Soybest; Grain States Soya, West Point, NE.