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Modification of the feeding behavior of dairy cows through live yeast supplementation

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ABSTRACT

The objective of this study was to determine if the feeding behavior of dairy cows is modified through live yeast supplementation. Twelve lactating Holstein dairy cows (2 primiparous and 10 multiparous) were individually exposed, in a replicated crossover design, to each of 2 treatment diets (over 35-d periods): (1) a control TMR and (2) a control TMR plus 1×10^{10} cfu/head per day of live yeast (*Saccharomyces cerevisiae* CNCM I-1077; Levucell SC20; Lallemand Animal Nutrition, Montreal, QC, Canada). Milk production, feeding, and rumination behavior were electronically monitored for each animal for the last 7 d of each treatment period. Milk samples were collected for the last 6 d of each period for milk component analysis. Dry matter intake (28.3 kg/d), eating time (229.3 min/d), and rate (0.14 kg of dry matter/min) were similar between treatments. With yeast supplementation, meal criteria (minimum intermeal interval) were shorter (20.0 vs. 25.8 min), translating to cows tending to have more meals (9.0 vs. 7.8 meals/d), which tended to be smaller in size (3.4 vs. 3.8 kg/meal). Yeast-supplemented cows also tended to ruminate longer (570.3 vs. 544.9 min/d). Milk yield (45.8 kg/d) and efficiency of production (1.64 kg of milk/kg of dry matter intake) were similar between treatments. A tendency for higher milk fat percent (3.71 vs. 3.55%) and yield (1.70 vs. 1.63 kg/d) was observed when cows were supplemented with yeast. No differences in milk fatty acid composition were observed, with the exception of a tendency for a greater concentration of 18:2 *cis*-9,*cis*-12 fatty acid (2.71 vs. 2.48% of total fatty acids) with yeast supplementation. Yeast-supplemented cows had lower mean ruminal temperature (38.4 vs. 38.5°C) and spent less time with rumen temperature above 39.0°C (353.1 vs. 366.9 min/d), potentially indicating improved rumen pH conditions. Overall, the results show that live yeast supplementation tended to improve meal patterns and rumination, rumen temperature, and milk fat production.
Key words: live yeast, rumination, meal pattern, behavior

INTRODUCTION

Live yeast supplementation to the diet has been associated with increased potential to enhance fiber digestion in the rumen and prevention of a decline in rumen pH. These effects have been typically attributed to decreased lactic acid production, increased utilization of lactic acid by some bacteria [creating more favorable conditions for fiber-degrading (cellulolytic) bacteria within the rumen], and overall greater microbial synthesis in the rumen (Chaucheyras et al., 1996; Newbold et al., 1996; Chaucheyras-Durand et al., 2008). This improved rumen environment may lead to increased feed efficiency of dairy (de Ondarza et al., 2010) and beef cattle (Erasmus et al., 2009).

Some evidence suggests that the provision of live yeast (*Saccharomyces cerevisiae*) may have the potential to modify dairy cow feeding behavior patterns. In a study by Bach et al. (2007), supplementation of active dry yeast not only improved ruminal pH in a small sample of loose-housed lactating cows, but also affected cow eating behavior. Cows supplemented with active dry yeast had a shorter interval between meals (3.32 h) than nonsupplemented cows (4.03 h), suggesting that they ate more frequently. It could be hypothesized that the greater fiber digestibility typically associated with live yeast supplementation may help speed up the passage of feed and, thus, increase appetite and feed intake. This could also explain the reduced interval between meals observed by Bach et al. (2007), which, if translated into greater meal frequency, may also help control rumen pH (Allen, 1997). Some recent evidence has been reported for beef cattle that active dry yeast increases eating frequency (Loncke et al., 2012). Thus, even though live yeasts are well documented to interact with lactic acid-producing and lactic acid-consuming bacteria (Chaucheyras-Durand et al., 2008), Bach et al. (2007) suggested that, among the mechanisms involved

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in the reduction of subclinical acidosis associated with live yeast supplementation, meal frequency may be an important factor to consider. Further research is required using a more powerful design and greater treatment adaptation period to determine if an effect of live yeast supplementation on meal patterning in lactating dairy cows truly exists. In addition to feeding and meal patterns, rumination activity would also be of interest to capture. A more favorable rumen fermentation environment would also be predicted to result in greater rumination activity (DeVries et al., 2009), which would further contribute to stabilization of rumen pH.

Interestingly, in a recent study by Desnoyers et al. (2009b), goats that were live yeast supplemented sorted their ration more (against fiber) than unsupplemented goats. Those researchers suggested that the live yeast-supplemented goats were able to cope with higher concentrate diets because they chose to eat a less-fibrous diet than the offered one. Even though feed sorting in dairy cattle has typically been viewed to contribute to depressions in rumen pH (DeVries et al., 2008), various reports have been published of lactating dairy cows decreasing their selection against long fibrous forage particles in attempt to mediate the effect of low rumen pH (Keunen et al., 2002; Yang and Beauchemin, 2006; DeVries et al., 2008). Given these findings, it would be interesting to also determine if dairy cattle, when supplemented with a live yeast product that has the potential to increase rumen pH, also change their selective consumption (sorting) patterns.

The objective of the current study was to determine if the feeding and rumination behavior patterns of lactating dairy cows can be modified through the supplementation of a feed additive that alters rumen fermentation. The secondary objective of the current research was to determine if the selective consumption patterns of dairy cows also change in response to that altered fermentation. We hypothesized that altering rumen fermentation through adding a direct-fed microbial (*S. cerevisiae*) to the TMR of lactating dairy cows would result in greater meal frequency and rumination activity. Further, we hypothesized that the sorting in favor of long fibrous particles in the ration may be less prevalent in cows supplemented with live yeast.

MATERIALS AND METHODS

Animals and Housing

Twelve lactating Holstein dairy cows, including 2 primiparous and 10 multiparous (parity = 2.2 ± 0.4; mean ± SD), were used in our study. The animals were 48.6 ± 16.5 DIM and were producing 48.5 ± 7.6 kg of milk at the beginning of the trial. The cows were housed 6 at a time in a freestall research pen located at the University of Guelph, Kemptville Campus Dairy Education and Innovation Centre (Kemptville, ON, Canada). Cows had access to 6 freestalls with waterbeds (DCC Waterbeds, Advanced Comfort Technology Inc., Reedsburg, WI). The waterbeds were topped with wood shavings; bedding was replaced as needed. Manure was manually scraped to within reach of the alley scrapers 2× per day at 0600 and 1800 h. Cows were milked 3× per day (at 0700, 1400, and 2100 h) using a robotic milking system (Lely A3 Next, Lely Industries N.V., Maassluis, the Netherlands). At the specified milking times, cows were moved from the research pen into a small holding area adjacent to the robotic milker, where they were milked individually and sequentially. Cows did not receive any supplemental feed from the robotic milking system while being milked. The experiment was conducted from December 29, 2012, to May 30, 2013. The average environmental temperature during the experimental period was 0.2 ± 10.3°C. Use of cows and experimental procedures were approved by the University of Guelph Animal Care Committee. Cows were managed according to the guidelines set forth by the Canadian Council on Animal Care (CCAC, 2009).

Experimental Design

The number of animals required per treatment was determined through sample size and power analysis (Morris, 1999) to detect a 10% level of observed difference for the primary outcome variables, including feeding behavior and feed sorting. Estimates of variation for these variables were based on previously reported values (Leonardi and Armentano, 2003; Bach et al., 2007; Ferraretto et al., 2012). Cows were divided into 2 groups of 6, which were balanced according to DIM, milk production, and average parity. Within each group, cows were randomly exposed to each of 2 treatment diets in a replicated crossover design (with groups replicated over time), with 35-d treatment periods. The treatment diets were (1) a control TMR (Tables 1 and 2) and (2) a control TMR plus 1×10^{10} cfu/head per day of live yeast (*Saccharomyces cerevisiae* CNCM I-1077; Levucell SC20; Lallemand Animal Nutrition, Montreal, QC, Canada). The control diet was formulated to meet the nutrient requirements of lactating dairy cows at 90 DIM producing 45 kg/d (NRC, 2001). Cows received 28 d of adaptation to each treatment followed by 7 d of data collection.

Feeding Procedure

Cows were individually assigned to 1 roughage intake feed bin (Insentec B.V., Marknesse, the Netherlands) to