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Effects of transient changes in silage dry matter concentration on lactating dairy cows

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ABSTRACT

Transient changes in the dry matter (DM) concentration of silages often occur, which will cause transient changes in the ration. To determine the effects of a transient change in silage DM, 24 Holstein cows (116 d in milk) were used in an 8 replicated 3 × 3 Latin square design with 21-d periods. Treatments were (1) control, (2) unbalanced (UNBAL), and (3) balanced (BAL). The control diet was designed to have a consistent day-to-day forage:concentrate ratio of 55:45 on a DM basis. The UNBAL and BAL diets were the same as the control diet for most of the period except during two 3-d bouts when water was added to the silage (simulating a rain event) to cause a 10-percentage unit decrease in silage DM concentration. During the bouts, the UNBAL diet was the same as that of the control on an as-fed basis, but on a DM basis, the forage:concentrate ratio decreased to 49:51, which reduced dietary concentrations of DM (63.9 vs. 66.2%) and forage NDF (21.0 vs. 23.6%), and increased starch (30.4 vs. 28.4%). The BAL treatment corrected for the change in silage DM by an increase in the inclusion of wet silage and had the same composition as the control diet on a DM basis, except for ration DM (66.2 vs. 63.9%). Over the 21-d period, treatment did not affect DM intake (DMI; 24.0 kg/d); however, DMI of cows on the UNBAL and BAL treatments tended to decrease during the wet bouts, especially during the second bout. The day following both bouts, DMI of cows fed BAL and UNBAL diets were greater than that of cows fed the control diet, which contributed to the lack of a treatment effect on DMI over the entire period. Milk production was greater for the UNBAL than control cows (39.8 vs. 39.3 kg/d) over the 21-d period. That difference was largely caused by increased milk yield during the first bout by cows on the UNBAL diet. Over the 21-d period, milk yield did not differ between control and BAL cows. Some small differences in milk fat and protein concentrations (≤0.1 percentage units) were observed between treatments. Total-tract digestibility of most nutrients was not affected by treatment. Overall, a 10-percentage unit decrease in silage DM over short-term bouts (with or without total mixed ration adjustment) had only minor effects on DMI, milk yield, and composition.
Key words: silage variability, dry matter change, precision feeding

INTRODUCTION

The nutrient concentrations of feedstuffs vary substantially over short periods of time (Weiss et al., 2012), which can cause variation in the nutrient composition of the TMR. Forages often comprise more than half the diet DM fed to lactating dairy cows (Shaver, 2004), and a change in forage composition could cause a substantial change in the composition of the TMR. Rations are formulated on a DM basis; however, ingredients are included in the mixture on an as-fed basis. Average ranges in the DM concentration of monthly samples of corn and alfalfa silage within a farm (over a 12-mo period) were 9 and 21 percentage units and ranges in daily samples over a 14-d period were 7 and 11 percentage units, respectively (Weiss et al., 2012). These large transient changes in water concentrations in silage could directly affect cows; and if as-fed inclusion rates were not adjusted for changes in DM concentration, the nutrient composition of the TMR would change and that may also affect the cow.

Milk yields and DMI are usually not affected by a long-term (weeks) difference in DM concentrations of TMR (Robinson et al., 1990; Leonardi et al., 2005; Fish and DeVries, 2012). However, the objective of the current experiment was to evaluate transient (days) changes in DM concentration of TMR such as that caused by a rainfall event on an uncovered silo. In previous studies, transient (1- to 3-d) decrease in silage DM of 3 to 8 percentage units decreased short-term DMI and milk production (Mertens and Berzaghi, 2009; Boyd and Mertens, 2010; Boyd and Mertens, 2011). Those studies have only been reported in abstract form and as-fed inclusion rates were not altered so that the concentra-

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tions of multiple nutrients (not just water) in the TMR changed. We hypothesized that a transient decrease in silage DM concentration would reduce DMI and milk yield, and in response to changes in the rumen fermentation (caused by abrupt changes in concentrations of dietary carbohydrates), milk FA would be altered and digestibility reduced when cows were fed a TMR that was not adjusted for the change in silage. However, if inclusion rates were adjusted, the transient change would not affect the cows.

MATERIALS AND METHODS

Cows, Diets, and Experimental Design

All procedures involving animals were approved by The Ohio State University Institutional Animal Care and Use Committee (Columbus). Twenty-four Holstein cows were blocked by parity (3 squares of multiparous and 5 squares of primiparous) and assigned to 1 of 6 treatment sequences in 8 orthogonally replicated 3 × 3 Latin squares with 21-d periods (starting August 6 and ending October 8). At the beginning of the experiment, cows averaged 116 DIM (±23d) and BCS of 2.9. Cows were moved into tiestalls and fed the control diet for 10 d before the first period.

Three dietary treatments were used in this experiment (Tables 1 and 2). The control was formulated to have a consistent forage-to-concentrate (**F:C**) ratio of 55:45 (DM basis) throughout the 21-d period. The forage DM consisted of 67% alfalfa silage and 33% corn silage (stored in separate glass-lined steel silos). The unbalanced (**UNBAL**) and balanced (**BAL**) diets were the same as the control diet for most of the period, except during 2 separate 3-d bouts that occurred on d 3 to 5 and on d 12 to 14 of each period. During those bouts, water was added to both silages to reduce their DM concentration by 10 percentage units. During the bouts, the UNBAL diet was the same as the control diet on an as-fed basis, but the F:C ratio was lower on a DM basis (49:51). During the bouts, the BAL diet was corrected for the change in silage DM concentration so that on a DM basis, the F:C ratio was the same as that of the control (55:45) but the F:C ratio on an as-fed basis was higher than that of the control and UNBAL treatments.

Cows were fed a TMR once daily and DMI was measured daily. Cows were fed for a target of 5% feed refusal, and feed refusal averaged 6% of feed offered (i.e., during bouts, cows did not run out of feed). Cows were milked twice daily and weights were recorded electronically at each milking. Milk samples (a.m. and p.m.) were obtained on 2 d each week (6 samples per period) so that we had 3 samples (a.m. and p.m.) taken during the bouts and 3 samples taken when all cows were fed the control diet for each period. Cows were weighed and

Table 1. Ingredient composition of the diets (% of DM)

	Treatment[1]		
Ingredient	Control	UNBAL	BAL
Alfalfa silage[2]	37.5	—	—
Corn silage[2]	17.5	—	—
Wet alfalfa silage[3]	—	32.5	37.5
Wet corn silage[3]	—	16.3	17.5
Corn (ground)	32.6	37.1	32.6
Treated soybean meal[4]	5.0	5.7	5.0
Dried distillers grains with solubles	3.0	3.4	3.0
Soybean hulls	2.1	2.3	2.1
Fat (animal-vegetable blend)	0.89	1.02	0.89
Trace mineral salt	0.51	0.58	0.51
Limestone	0.27	0.31	0.27
Magnesium oxide	0.12	0.14	0.12
Dicalcium phosphate	0.08	0.09	0.08
Mineral and vitamin premix[5]	0.53	0.61	0.53

[1]The control diet was fed to control cows at all times and to all other cows during the non-change periods. Cows on unbalanced (UNBAL) and balanced (BAL) diets were fed a mix of wetted silage during two 3-d bouts. As-fed inclusion rates for ingredients in the TMR for UNBAL cows were the same as for control cows, but as-fed rates were adjusted for the BAL treatment to achieve the same diet as the control treatment on a DM basis.

[2]Nutrient composition (on a DM basis) of alfalfa silage: 53.5% DM, 46.0% NDF, and 19.1% CP and corn silage: 36.4% DM, 36.0% NDF, and 35.9% starch.

[3]Silages were blended and water added to decrease DM concentration 10 percentage units.

[4]Aminoplus (Ag Processing Inc., Omaha, NE).

[5]Contained (as-fed basis) 58.6% biotin (220 mg/kg; DSM Nutritional Products Inc., Parsippany, NJ), 23.5% selenium premix (200 mg/kg), 1.9% Zn-methionine (Zinpro 100; Zinpro Corp., Eden Prairie, MN), 0.7% copper sulfate, 8.3% vitamin E (44 IU/g), 5.1% vitamin D (3,000 IU/g), and 1.9% vitamin A (30,000 IU/g).