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The effect of hybrid type and dietary proportions of corn silage on the lactation performance of high-producing dairy cows

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ABSTRACT

We evaluated the effects of corn silage hybrids [control vs. brown midrib (BMR)] and the proportion of corn silage in rations on the performance of high-producing dairy cows. The chemical composition of the corn silages was similar except for lignin, which was higher in the control hybrid [3.09%, dry matter (DM) basis] compared with the BMR hybrid (2.19%). The 30-h in vitro neutral detergent fiber (NDF) digestibility was also higher (62.8% of NDF) in the BMR hybrid than in the control hybrid (52.2%). Twenty-seven Holstein cows were fed 1 of 3 diets comprising 62% forage and 38% concentrate (DM basis) containing 35% (DM basis) corn silage from the control hybrid (NLO), 35% of the BMR hybrid (BLO), or 50% of the BMR (BHI). Cows were fed the diets in a replicated 3 × 3 Latin square design with 28-d periods. Intake of DM was similar among treatments but milk production was greater for cows fed BLO (50.1 kg/d) and BHI (51.1 kg/d) than for NLO (47.9 kg/d). Milk fat percentage was lower for cows fed BHI (3.37%) than for those fed BLO (3.55%) and NLO (3.56%) but yield of milk fat was similar among treatments. Yield and percentage of milk protein was higher for cows in BHI compared with NLO. The concentration of milk urea N was lower in cows fed BHI (14.0 mg/dL) than in those fed NLO (14.7 mg/dL) and intermediate for BLO (14.5 mg/dL). The yield of 3.5% fat-corrected milk was higher in cows fed BLO (50.2 kg/d) than in NLO (48.2 kg/d) and was intermediate for BHI (49.8 kg/d). The total-tract digestibility of dietary DM, organic matter, starch, and crude protein was lower for cows in NLO compared with the other treatments. The total-tract digestibility of NDF was highest for BHI (54.4%), intermediate for BLO (50.9%), and lowest for NLO (43.2%). We conclude that BMR corn silage can be included in rations at moderate and high proportions of a total ration, resulting in high levels of milk production.

Key words: corn silage, dairy cow, brown midrib corn

INTRODUCTION

Brown midrib (**BMR**) forages are low in lignin and, when fed to cows, result in increased milk production compared with non-BMR hybrids (Eastridge, 1999; Oliver et al., 2004; Dann et al., 2008). In a meta-analysis of corn silage hybrids fed to lactating dairy cows, Ferraretto and Shaver (2013) reported that DMI, milk production, and protein yield were 1.6, 1.3, and 0.05 kg/cow per day, respectively, greater for BMR than for control silages. Utilizing high-quality forages such as BMR corn silage is becoming more important, especially because higher proportions of forages are being fed to high-producing lactating dairy cows (Chase and Grant, 2013). This practice has the potential to improve feed efficiency from forage sources, reduce the use of high-cost concentrates, and improve animal health. However, most past studies evaluating BMR corn silage incorporated it at only moderate levels in the TMR (commonly at 35–40% of the TMR DM; Castro et al., 2010; Holt et al., 2010). Although several studies have evaluated the feeding value of BMR corn silage when incorporating it at varying levels to the diet, DMI and milk production were only moderately high in those studies.

Besides the increased proportion of forages being fed to lactating dairy cows, a current trend has been to include higher proportions of corn silage in those diets. Reasons for this practice include higher DM yields from corn and easier ensiling of corn silage, because of its lower buffering capacity compared with alfalfa. For example, Cherney et al. (2004) reported that cows fed a diet containing 60% of the DM from BMR corn silage tended to produce more milk than cows fed similar diets but with conventional hybrids. Thus, the objective of our study was to evaluate the performance of high-producing lactating dairy cows fed BMR corn silage that was included at moderate and high levels in the diet and compare performance to that of cows fed a control corn silage included at a moderate level in the diet. Our hypothesis was that cows fed BMR corn silage would be more productive than cows fed control corn silage and that BMR corn silage could provide a significant proportion of the total ration DM in a high-forage diet fed to relatively high producing cows.

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MATERIALS AND METHODS

A control (normal, **NML**) corn silage hybrid (Mycogen TMF2H699, Mycogen Seeds, Dow AgroScience, Indianapolis, IN) and a BMR hybrid (Mycogen F2F66, Mycogen Seeds) were used in this study. Seeds were planted in silt loam soil in separate test plots in the spring of 2012 at the University of Delaware dairy farm (Newark). Corn hybrids were seeded at a theoretical planting density of 74,100 seeds/ha and spaced with 0.76 m between rows. Agronomic management for both hybrids was similar throughout the growing season. Corn was harvested in September 2012 when the whole-plant DM was approximately 38% for both corn hybrids, using a pull-type harvester (John Deere 3975, Moline, IL) equipped with a mechanical processor (roller gap setting of 1.40 mm). Corn plants were chopped at a theoretical length of cut of 19 mm and stored in bag silos (AgBag Systems Inc., St. Nazianz, WI) for 7 mo before the start of feeding.

A lactation trial was conducted from March to June 2013 at the University of Delaware dairy farm. The Agricultural Animal Care and Use Committee, College of Agriculture and Natural Resources, University of Delaware approved care and handling of cows (Anonymous, 1989). Twenty-seven Holstein cows (3 primiparous and 24 multiparous) averaged 742 ± 97 kg of BW, 94 ± 39 DIM, 29 ± 4 kg/d of DMI, and 53 ± 9 kg of milk/d at the start of the study. Cows were housed in a sand-bedded, freestall barn equipped with Calan gates (American Calan, Northwood, NH) for individual feeding and monitoring of daily intake. During a 2-wk pretrial period, cows were acclimated to the gates and fed a pretrial diet consisting of 25% of hybrid TMF2H699, 25% of BMR hybrid F2F66, 12% alfalfa haylage, and 38% concentrate (DM basis). Cows were blocked by pretreatment milk production, DIM, BW, DMI, and lactation number and randomly assigned to 1 of 3 treatments in a simultaneously replicated 3 × 3 Latin square design with 28-d periods. The first 21 d of each period were used as an adaptation period, and data collected during the last 7 d were used for statistical analysis. The rations (Table 1) contained (1) 35% of the total ration DM from hybrid TMF2H699 (**NLO**), (2) 35% from BMR hybrid F2F66 (**BLO**), or (3) 50% from BMR hybrid F2F66 (**BHI**). The remaining proportions of the rations comprised cottonseed, concentrates (Table 2), and other forages (Table 3). The TMR were formulated using the CPM-Dairy Nutrition Model (version 3.0; Cornell University, Ithaca, NY; University of Pennsylvania, Philadelphia, PA; William H. Miner Agricultural Research Institute, Chazy, NY) to be isonitrogenous and isocaloric and were balanced to satisfy or exceed the nutrient requirements of the test animals (NRC, 2001) at the start of the trial. Rations were offered once daily at 0800 h and provided about 110% of the previous day's consumption to ensure ad libitum intake. Refusals were measured daily before feeding. Cows had access to fresh clean water at all times.

Samples of all individual feeds and TMR were collected 3 times per week and composited weekly for chemical analyses. Feed samples were dried in a forced-draft oven (Isotemp Oven model 750F, Fisher Scientific, Dubuque, IA) set at 60°C for 48 h, and DM content of feed ingredients was used for weekly adjustments of the TMR mixture. Feed samples were sent to Cumberland Valley Analytical Services (Hagerstown, MD) for nutrient analyses through standard wet chemistry methods. Dried forages, concentrates, and TMR were ground to pass a 1-mm sieve using a Wiley mill (Arthur H. Thomas, Philadelphia, PA). The NDF content of samples was analyzed using sulfite and amylase according to the procedures of Van Soest et al. (1991), and ADF was analyzed as described by Robertson and Van Soest (1981). Acid detergent lignin was determined using the procedure outlined by Goering and Van Soest (1970). Ash content was determined according to AOAC International (2000) methods with the modification of using 1.5-g sample weights and a furnace temperature of 535°C for 4 h. Total N were determined by total combustion of samples in a Leco CNS 528 Analyzer (Leco Corp., St. Joseph, MI) and was multiplied by

Table 1. Ingredient proportions of the TMR fed during the treatment period (% DM basis)

	Treatment[1]		
Ingredient	NLO	BLO	BHI
Corn silage, Mycogen TMF2H699[2]	35		
Brown midrib corn silage, Mycogen F2F665[2]		35	50
Alfalfa haylage	20	20	5
Grass hay	4	4	4
Cottonseed	3	3	3
Concentrate	38	38	38

[1]NLO = diet containing 35% (DM basis) normal corn silage; BLO = diet containing 35% (DM basis) brown midrib (BMR) corn silage; BHI = diet containing 50% (DM basis) BMR corn silage.

[2]Mycogen Seeds, Dow AgroSciences (Indianapolis, IN).