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Effects of feeding brown midrib corn silage with a high dietary concentration of alfalfa hay on lactational performance of Holstein dairy cows for the first 180 days of lactation[1]

M. S. Holt,* J.-S. Eun,*[2] C. R. Thacker,*[3] A. J. Young,* X. Dai,† and K. E. Nestor Jr.‡
*Department of Animal, Dairy, and Veterinary Sciences, and
†Utah Agricultural Experiment Station, Utah State University, Logan 84322
‡Mycogen Seeds, Indianapolis, IN 46268

ABSTRACT

This experiment was conducted to test a hypothesis that lactating dairy cows fed 35% brown midrib (BMR) corn silage and 25% alfalfa hay (dry matter (DM) basis) would consume more DM around peak lactation compared with those fed conventional corn silage (CS), resulting in longer peak milk production. Twenty-eight multiparous Holstein cows were used starting at the onset of lactation through 180 d in milk (DIM). Treatments were formulated to maintain a forage-to-concentrate ratio of 60:40, differing only in the CS hybrids used. Two dietary treatments were assessed in a completely randomized design: total mixed ration based on conventional CS (CCS) and total mixed ration based on BMR silage. Through peak lactation (1–60 DIM), DM intake was not different between dietary treatments, whereas DM intake post-peak lactation (61–180 DIM) tended to increase by feeding the BMR diet compared with the CCS diet (25.8 vs. 24.7 kg/d). Cows fed the BMR diet tended to lose less body weight through peak lactation compared with those fed the CCS diet (−0.22 vs. −0.52 kg/d). Although milk yield was not different between dietary treatments through peak lactation, milk yield post-peak lactation increased by feeding the BMR diet compared with the CCS diet (41.0 vs. 38.8 kg/d). Yield of 3.5% fat-corrected milk was similar between dietary treatments throughout the experiment (41.4 kg/d, on average), but milk fat concentration decreased by feeding the BMR diet compared with the CCS diet post-peak lactation (3.47 vs. 3.80%). Overall milk protein concentration was similar between dietary treatments throughout the experiment (2.96%, on average), whereas milk protein yield tended to be higher for the BMR diet post-peak lactation compared with the CCS diet (1.19 vs.1.13 kg/d). Feeding BMR silage with a high dietary concentration of alfalfa hay maintained more body weight, but did not affect milk production through peak lactation; however, cows fed the BMR diet post-peak lactation consumed more feed and maintained longer peak milk yield, leading to greater overall milk production and milk protein yield.
Key words: brown midrib corn silage, alfalfa hay, stage of lactation, feed intake

INTRODUCTION

Observations by producers and dairy nutritionists indicate that over the past decade, dairy producers have increased their use of corn silage (**CS**) as a forage source in dairy rations. This has been influenced by the high price of feed, especially corn grain, and the high energy content of CS. Feeding forage levels at 55 to 60% of dietary DM is becoming more common, but lack of energy from concentrates and distention from rumen fill may limit DMI and reduce performance of high-producing dairy cows. Intake of DM is critical for dairy cows to achieve high milk production. Therefore, great emphasis has been placed on dietary factors affecting DMI of lactating dairy cows. Physical fill can be the most dominant mechanism limiting DMI for high-yielding cows around peak lactation (Allen, 2000), but it may contribute less in early lactation (Ingvartsen and Andersen, 2000). During the transition period, control of feed intake is likely dominated by hepatic oxidation of NEFA (Allen et al., 2009). At freshening, DMI does not meet the energy requirements for maintenance and production of high-producing cows. This results in a negative energy balance accompanied by an increase in the incidence of various metabolic disorders and a reduction in reproductive performance (van Knegsel et al., 2005). Thus, minimizing negative energy balance and maximizing energy intake are among the most critical management aspects associated with feeding dairy cows in early lactation. Finding an optimal bal-

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[1]Approved as Journal Paper Number 8436 of the Utah Agricultural Experiment Station, Utah State University, Logan.
[2]Corresponding author: jseun@usu.edu
[3]Present address: School of Veterinary Medicine, Utah State University, Logan 84322.

ance between physically effective fiber and readily fermentable carbohydrates is difficult but crucial not only for maintaining proper ruminal metabolism (Zebeli et al., 2006; Plaizier et al., 2008), but also for maintaining a stable metabolic health status while enhancing productivity (Ametaj et al., 2010; Zebeli et al., 2011).

Peak milk yield can be maximized by feeding diets with low rumen-fill capacity that are typically highly fermentable. The rumen-filling effect of diets is influenced most by concentration, digestibility, and fragility of forage NDF (Allen and Bradford, 2011). Feeding forages with enhanced digestibility of NDF has been reported to improve DMI and milk yield (Oba and Allen, 1999). Corn silage with the brown midrib mutation has been well documented to have higher fiber degradability and will likely increase DMI and milk yield compared with cows fed conventional corn silage (**CCS**; Eastridge, 1999; Gencoglu et al., 2008). Several (Ebling and Kung, 2004; Gehman et al., 2008; Castro et al., 2010), but not all experiments (Taylor and Allen, 2005c; Weiss and Wyatt, 2006; Kung et al., 2008) feeding brown midrib (**BMR**) silage, have reported improved lactational performance of dairy cows. Inconsistent effects of BMR silage have been caused by various factors, including cows differing in the physiological state and duration of experiment (Taylor and Allen, 2005a; Castro et al., 2010). Therefore, understanding physiological changes occurring through lactation and the control of feed intake are critical to diet formulation for BMR silage-based diets.

We hypothesized that feeding 35% BMR silage in a 60% forage diet (DM basis) would result in increased DMI of lactating dairy cows around peak lactation compared with feeding CCS, causing longer peak milk production. The objective of this study was to evaluate the long-term effects of feeding BMR silage with good-quality alfalfa hay (**AH**) on DMI, productivity, and BW of high-producing dairy cows from the onset of lactation through 180 DIM.

MATERIALS AND METHODS

The dairy cows used in this study were cared for according to the Live Animal Use in Research Guidelines of the Institutional Animal Care and Use Committee at Utah State University, Logan. The study was conducted at the Caine Dairy Research Center (Wellsville, UT), Utah State University from February 9, 2011, to October 17, 2011.

Cows and Experimental Diets

Twenty-eight multiparous Holstein cows were used starting at the onset of lactation through 180 DIM. Two dietary treatments were tested in a completely randomized design. Cows were assigned to 1 of 2 dietary treatments (n = 14) based on previous milk yield and parity. Treatments were based on CCS (62.2% 30-h NDF degradability) or BMR silage (71.4% 30-h NDF degradability) with good-quality AH (20.6% CP and 39.9% NDF) as the forage sources (Table 1). Treatments were formulated to maintain a forage-to-concentrate ratio of 60:40, differing only in the CS hybrids used. Treatments were TMR based on CCS and TMR based on BMR silage (Table 2). The diets were typical of high-producing dairy cows in the Intermountain West (i.e., Utah, Idaho, Wyoming, Montana, and parts of Arizona and Nevada) with 42% of the forage coming from good-quality AH. Rations were formulated based on NRC (2001) recommendations to provide sufficient NE_L, MP, vitamins, and minerals to produce 40 kg of milk/d with 3.5% fat and 3.0% true protein, with the inclusion of Rumensin (Elanco Animal Health, Greenfield, IN).

Two CS hybrids, brown midrib corn hybrid (Mycogen F2F569; Mycogen Seeds, Indianapolis, IN) and conventional corn hybrid (DeKalb DKC61-72; Monsanto Co., St. Louis, MO) were planted during spring 2010 at the Utah State University South Farm (Wellsville).

Table 1. Chemical composition (means ± SD) of forages (n = 8)

	Forage[1]		
Item	CCS	BMR	Alfalfa hay
DM, %	29.2 ± 2.20	30.6 ± 2.90	90.7 ± 1.60
OM, % of DM	94.6 ± 0.43	93.4 ± 0.46	89.2 ± 1.11
CP, % of DM	8.62 ± 0.25	8.78 ± 0.31	20.6 ± 0.35
NDF, % of DM	46.4 ± 2.12	50.7 ± 2.74	39.9 ± 4.34
IVNDFD,[2] %	62.2 ± 2.96	71.4 ± 1.59	ND[3]
ADF, % of DM	24.9 ± 1.60	27.7 ± 2.27	29.4 ± 3.50
Starch, % of DM	22.6 ± 0.41	21.7 ± 0.37	ND

[1]CCS = conventional corn silage; BMR = brown midrib corn silage.

[2]IVNDFD = NDF digestibility measured at 30 h of incubation in vitro.

[3]ND = not determined.