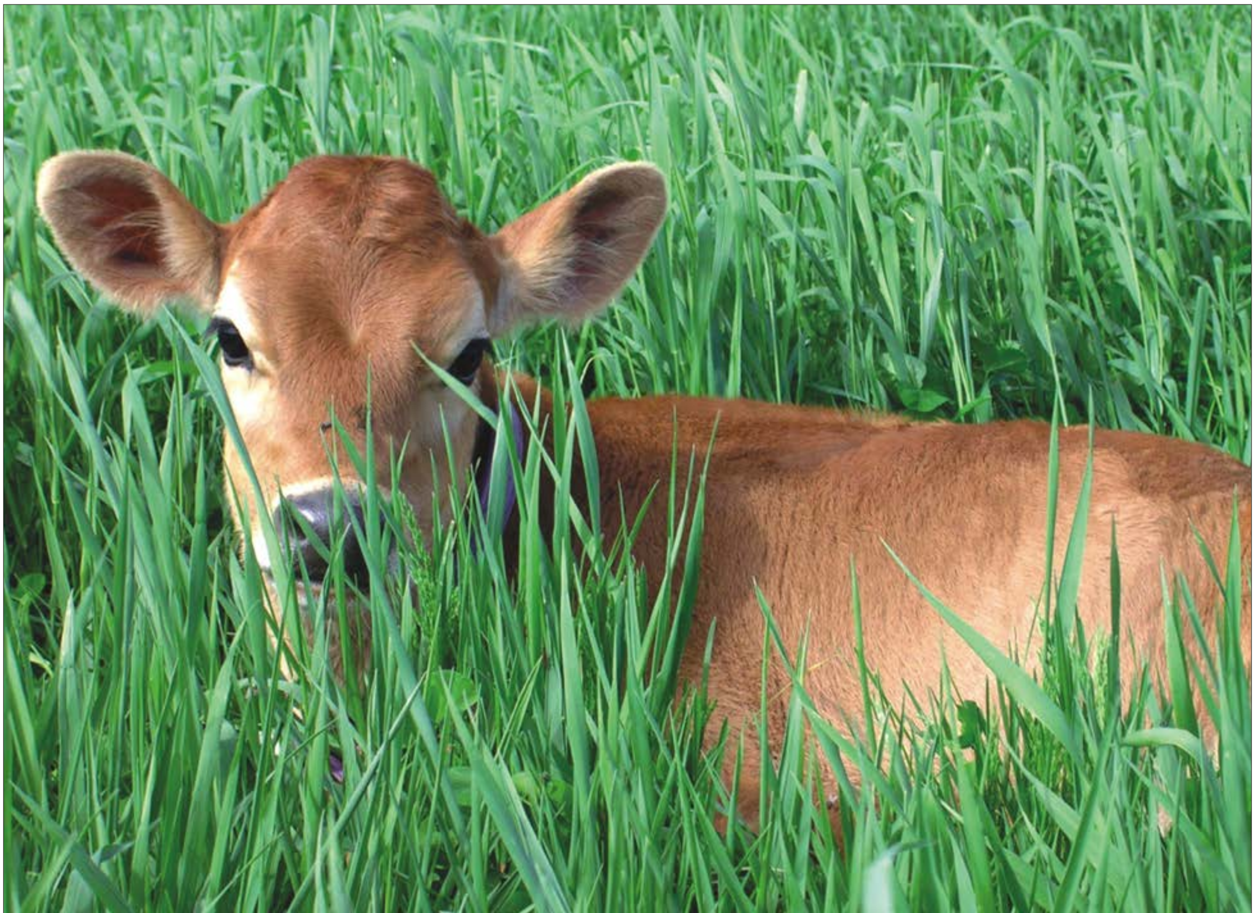

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Effects of Replacing Corn Silage and Alfalfa Hay with Master Graze Silage on Dairy Cows Performance

A.M. Salamone, A.A. AbuGhazaleh and C. Stuemke
Department of Animal Science, Food and Nutrition, Southern Illinois University Carbondale, IL 62901, United State

Corresponding Author: Amer A. AbuGhazaleh, Department of Animal Science, Food and Nutrition Agriculture Bldg, Room 119, Southern Illinois University, Carbondale, IL 62901-4417, United State Tel: (618) 453-1767 Fax: (618) 453-5231

ABSTRACT

A new midrib corn hybrid called Master Graze (MG) has been recently introduced in the US as a new forage source for cattle. However, before recommending its use to livestock producers, it's important to evaluate its nutritional value. Therefore, the objective of this study was to evaluate the effects of using MG silage as a forage source in a lactating dairy cow's diet on feed intake, milk yield, milk composition and nutrient digestibility. Sixteen Holstein cows, in mid lactation (120±19 DIM), were divided into four treatment groups (n = 4 cows/treatment) and fed treatment diets for 4 consecutive periods with each period consisted of 21 days. The cows on the control diet (CON) were fed a 60:40 forage:concentrate diet (dry matter (DM) basis) with corn silage and alfalfa hay as the forage source (1:1; DM basis). For treatment groups, the MG silage substituted the forage mix at 16% (MAS-16), 33% (MAS-33) and 50% (MAS-50) on a DM basis. All diets were formulated to be isonitrogenous. Cows were fed the treatment diets as a total mixed ration once daily. Substituting the corn silage-alfalfa hay mix with the MG silage at the three tested levels had no effects ($p>0.05$) on feed intake or milk production. Milk fat percentages and yields and milk protein percentages and yields were similar ($p>0.05$) among treatment diets. Relative to CON diet, the apparent digestibility of DM and OM were higher ($p<0.05$) in cows fed the MAS-50 diet and tended to increase ($p<0.11$) in cows fed the MAS-16 and MAS-33 diets. The apparent digestibility of NDF in cows fed the MG diets were higher ($p<0.05$) than in cows fed the CON diet, with MAS-50 being the highest ($p<0.01$. The apparent digestibility of crude protein was higher ($p<0.05$) in cows fed the MAS-50 diet in comparison to cows fed the CON diet. In conclusion, the inclusion of MG silage in lactating dairy cow's diet had no effects on cow's feed intake, milk production or milk composition but improved the digestibility of nutrients. The MG silage may replace 50% of dietary corn silage-alfalfa hay mix in a lactating dairy cows ration without any adverse effects on lactating dairy cow's performance.

Key words: Forage, dairy, milk, nutrient digestibility, lactating cows

INTRODUCTION

Alfalfa hay and corn silage are typically the two main forages fed to dairy cows in North America. However, in recent years, climate conditions such as drought and high summer temperature and the accelerated growth in ethanol production from corn have substantially affects the mass production these forages in the US (USDA, 2012). Identification a viable alternative forage crops to fill ecological niches prone to crop failure would reduce risk faced by the livestock industry. Hence, in recent years forage hybrids have been developed specifically to replace the conventional forages fed to livestock animals (Oliver *et al.*, 2004; Miron *et al.*, 2007; Dann *et al.*, 2008).

Genetic approaches have been used in recent years to improve forages nutritional value and digestibility. For example, Brown midrib (BMR) forage genotypes have greater fiber digestibly than conventional forages due to their lower lignin content and altered lignin chemical composition (Cherney *et al.*, 1991; Vogel and Jung, 2001; Dann *et al.*, 2008). Different in situ and in vitro digestion studies have shown that BMR forages have greater extent of fiber digestion than their conventional counterparts (Cherney *et al.*, 1991; Gerhardt *et al.*, 1994; Grant *et al.*, 1995). Several studies (Oba and Allen, 1999, 2000; Dann *et al.*, 2008) reported greater milk production and feed intake when dairy cows fed BMR forage vs. conventional forage.

Recently, a new BMR corn hybrid called Master Graze (MG) was developed by Master's Choice Inc. (Anna, IL). Master Graze is a crop that can be planted and harvested earlier than the rest of the crops and has the potential to make time management in the field more efficient. Master Graze can be planted in early spring when soil temperatures are between 50-55°F, in comparison to Sorghum Sudan that requires a soil temperature of 60-65°F. The ability of MG to grow at a lower soil temperature allows fields to be planted five to six weeks earlier than most other crops and then it can be harvested within seven to eight weeks. Although, MG may provide alternative forage source to dairy producers, research is needed be evaluated and determine if MG is a viable substitute to conventional forages. Data on the feeding value of MG silage for ruminants is not available and currently, no published work has determined the potential effects of feeding MG silage as a forage source to lactating dairy cows (Master's Choice Inc., Anna, IL). Therefore, the objective of this study was to determine the effect of substituting MG silage for conventional corn silage and alfalfa hay on lactation performance and nutrient digestibility when fed to lactating Holstein dairy cows.

MATERIALS AND METHODS

Master Graze (Master's Choice Inc., Anna, IL) was planted in a 3.89 hectare (ha) field (Southern Illinois University Carbondale Dairy Farm, Carbondale, IL) on May 12, 2010. The MG was planted at a seeding rate of approximately 74,131 plants ha^{-1}. An addition of 45.36 kg of N was applied on June 2, 2010, three weeks after the MG was planted. The field was also treated with a Princep and Atrazine pesticide. The MG was chopped on July 11, 2010 using a conventional pull-behind chopper (Ford New Holland 790, New Holland, PA) and chopped into particle lengths of 3/4-1 inch long. The chopped forage was then bagged into a 6 foot by 150 foot silage bag and sealed for eight weeks, until it was opened at the start of the study on September 21, 2010.

Animals and diets: Sixteen Holstein cows, in mid lactation (120±19 DIM), were used in a balanced 4×4 Latin square design with 3 week periods. The cows were divided into four groups according to days in milk, milk yield and parity. The cows were then housed in four separate pens (4.57×9.14 m) with four cows per pen. The trial consisted of a 2 week adaptation period followed by a 1 week experimental period. The cows were fed one of four treatment diets once daily as a Total Mixed Ration (TMR) for 4 consecutive periods. The control diet (CON) consisted of a 60:40 forage:concentrate diet (DM basis) with Corn Silage (CS) and Alfalfa Hay (AH) as the forage source (1:1; DM basis). The concentrate mixture consisted of ground corn, dried distillers grain, soybean meal, dried molasses and a mineral-vitamin mix (Table 1). For the three treatment groups, the MG

Table 1: The ingredients and chemical composition of treatment diets

	Diet				
Item	CON	MAS-16	MAS-33	MAS-50	MSE
Ingredients (g kg^{-1} of DM)					
Corn silage	300	250	200	150	
Alfalfa hay	300	250	200	150	
Master graze silage	0	100	200	300	
Ground corn	174	174	174	174	
Soybean meal	80	80	80	80	
Dried corn distillers	100	100	100	100	
Molasses, dried	24	24	24	24	
Limestone	9	9	9	9	
Di-calcium phosphate	2.9	2.9	2.9	2.9	
Magnesium oxide	0.6	0.6	0.6	0.6	
Salt white	3.2	3.2	3.2	3.2	
Salt-TM	2.5	2.5	2.5	2.5	
Sodium bicarbonate	3	3	3	3	
Urea 45%	0	1	2	3	
Vit. E 20,000	0.2	0.2	0.2	0.2	
Vit. ADE Mix	0.6	0.6	0.6	0.6	
Chemical composition (g/100 g of DM)					
Dry matter	73.42^{a}	69.39^{b}	65.36^{c}	61.33^{d}	0.082
Organic matter	92.99^{a}	92.29^{b}	91.59^{c}	90.89^{d}	0.130
Starch	26.81^{a}	25.13^{b}	23.52^{c}	21.82^{d}	0.211
Neutral detergent fiber	40.73^{d}	42.41^{c}	44.08^{b}	45.76^{a}	0.109
Acid detergent fiber	25.88^{d}	26.51^{c}	27.14^{b}	27.78^{a}	0.165
Lignin	5.26	5.25	5.24	5.23	0.106
Crude protein	14.83^{a}	14.32^{b}	13.81^{c}	13.31^{d}	0.047
Ether extract	2.43^{a}	2.37^{c}	2.31^{bc}	2.26^{b}	0.024
Ash	7.01^{d}	7.71^{c}	8.41^{b}	9.11^{a}	0.130

CON: Control diet, MAS-16: Control diet with 16% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), MAS-33: Control diet with 33% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), MAS-50: Control diet with 50% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), Salt-TM: NaCl: 955-9.8, Zn: 10.0, Mn: 7.5, Fe: 6.0, Mg: 0.5, Cu: 0.32, I: 0.28, Co: 0.11, Values within rows with different superscripts are statistically different at $p<0.05$

silage was substituted in place of the corn silage and alfalfa hay in the forage mix at 16% (MAS-16), 33% (MAS-33) and 50% (MAS-50) on a DM basis. All diets were formulated to be isonitrogenous and meet the NRC (2001) nutrient requirements for lactating dairy cows. Protocols for this trial were approved by the Southern Illinois University Carbondale Institute of Animal Care and Use Committee. All the sixteen cows completed the study.

The cows were fed the treatment diets once daily (07:00 h) in amounts to provide approximately 10% orts for *ad libitum* consumption. The diet refusal rate and the total feed intake for each pen were recorded daily before feeding. Cows were milked twice a day at approximately 05:30 and 16:30 h and daily milk yield was recorded. Cows had free access to fresh water at all times except during milking times. Cow's body weight (BW) and BCS were recorded at the start of the experiment and at the end of each period.

Sampling: Feed ingredient samples were collected on day 7 of each week and DM content was determined by drying the samples in an oven at 55°C for 72 h. The samples were then ground to pass through a 2 mm screen using a Wiley mill (Arthur H. Thomas, Philadelphia, PA). The ingredient samples were then composited per ingredient per period and stored at room temperature until analyzed for DM, OM, starch, CP (LECO FP-528, St. Joseph, MI) and ether extract (ANKOM XT10, Macedon, NY), ADF, NDF (ANKOM 200 Fiber Analyzer, Macedon, NY) and lignin (AOAC, 2000; Van Soest *et al.*, 1991).

Milk samples were collected from each cow during the milking process by an automated milk sampler unit. Milk samples were collected from three consecutive pm and am milkings at the end of each period. The milk samples (am and pm) were composited per cow per day, amounts proportional to milk yield at each time and sent to Prairie Farms (Carlinville, IL) for analysis of fat, protein, lactose, total solids, Milk Urea Nitrogen (MUN) by mid infrared spectrophotometry (AOAC, 2000). Somatic Cell Counts (SCC) were determined using a Fossomatic 90 instrument (Prairie Farms, Carlinville, IL).

Digestibility: At the end of each period, the same two cows from each pen were used to determine nutrients digestibility coefficients. A fecal grab sample was obtained and acid-insoluble ash was used as an internal marker according to Van Keulen and Young (1977) for determining nutrients digestibility. The samples were taken at 0700, 1100 and 1900 h on day 20 and at 0300, 1500 and 2300 h on day 21 of each period to represent every 4 h in a theoretical 24 h time clock. Samples were dried in an oven at 55°C for 72 h. Samples were then ground to pass through a 2 mm screen using a Wiley mill (Arthur H. Thomas, Philadelphia, PA), composited for each cow and stored until analyzed for DM, OM, CP and NDF as described previously.

Statistical analysis: Data for milk composition, milk yield, BW and BCS were analyzed as a 4×4 Latin square design using the PROC MIXED of SAS (SAS/STAT, 2010) using the following model:

$$Y_{ijk} = \mu+D_i+P_j+C_k+e_{ijk}$$

where, μ is the overall mean, D is the diet effect, P is the period effect, C is the cow effect and e is the residual error. The diets and periods are the fixed effects and the cow is the random effect. Results are expressed as least square means with standard error of the means.

Data for feed intake and digestibility were also analyzed as a 4×4 Latin square design using the PROC MIXED SAS (SAS/STAT, 2010) using same model except pen was the random effect. Significance was declared at $p<0.05$.

RESULTS

The ingredients and the chemical composition of treatment diets are presented in Table 1. The chemical composition for forages and concentrate mix are presented in Table 2. The DM content of treatment diets was highest in the CON diet and decreased ($p<0.05$) as the level of MG silage in diets increased. The concentrations of NDF and ADF in treatment diets increased while the concentration of starch decreased as the level of MG silage in the diet increased. Although, diets were balanced to be isonitrogenous, after chemical analysis dietary CP content was highest with the CON diet and decreased ($p<0.05$) as the level of MG silage in diets increased.

The effects of substituting CS and AH with MG silage on dry mater intake (DMI), milk yield and milk composition are presented in Table 3. The inclusion of MG silage in treatment diets as a

Table 2: Chemical composition of dietary ingredients

	Ingredients			
Chemical composition (g/100 g of DM)	CS	MG	AH	CM
Dry matter	32.35	22.19	89.94	92.48
Organic matter	95.63	86.47	91.30	92.27
Starch	24.23	2.11	12.73	39.40
Neutral detergent fiber	47.39	69.08	57.17	24.85
Acid detergent fiber	29.04	43.02	44.33	9.66
Lignin	4.07	7.33	10.74	2.03
Crude protein	7.61	5.98	14.49	20.51
Ether extract	2.80	1.47	1.32	2.99
Ash	4.37	13.54	7.73	8.70

CS: Corn silage, MG: Master graze, AH: Alfalfa hay, CM: Concentrate mix

Table 3: Effects of substituting corn silage and alfalfa hay with Master Graze silage at different levels on feed intake, milk yield and milk composition

	Diet					
Item	CON	MAS-16	MAS-33	MAS-50	MSE	p-value
Dry matter intake (kg day^{-1})	19.42	19.19	19.67	19.22	0.270	0.35
Milk (kg day^{-1})	23.09	22.66	22.65	22.96	0.569	0.83
3.5% fat corrected milk (kg day^{-1})	24.44	23.54	23.72	24.22	0.647	0.48
Fat (%)	3.91	3.82	3.85	3.90	0.077	0.59
Fat (kg day^{-1})	0.89	0.85	0.86	0.80	0.028	0.38
Protein (%)	3.04	3.06	3.04	3.03	0.035	0.93
Protein (kg day^{-1})	0.70	0.68	0.69	0.69	0.018	0.84
Lactose (%)	4.33^{b}	4.37^{ab}	4.40^{a}	4.42^{a}	0.033	0.05
Lactose (kg day^{-1})	1.00	0.99	1.00	1.01	0.027	0.87
Total solids (%)	12.22	12.18	12.33	12.30	0.087	0.64
Total solids (kg day^{-1})	2.80	2.73	2.75	2.81	0.072	0.67
Milk urea nitrogen (%)	11.05^{a}	10.20^{b}	10.60^{ab}	10.96^{a}	0.340	0.05
Somatic cell count ($\times 10^3$ mL^{-1})	322.00	375.00	270.00	228.00	116.000	0.62
Body condition score	3.50	3.25	3.25	3.50	0.450	0.43
Body weight (kg)	573.00	588.00	587.00	601.00	123.000	0.45

CON: Control diet, MAS-16: Control diet with 16% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), MAS-33: Control diet with 33% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), MAS-50: Control diet with 50% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), Values within rows with different superscripts are statistically different at $p<0.05$

substitute for CS and AH had no effects ($p>0.05$) on feed intake and milk. Milk fat percentages, milk fat yield, protein percentages and milk protein yield were also not affected ($p>0.05$) by MG silage inclusions in treatment diets. Relative to the CON diet, milk lactose content was higher ($p<0.05$) in cows fed the MAS-33 and MAS-50 diets. Milk total solids, MUN, SCC and cows BW and BCS were also not affected ($p>0.05$) by MG silage inclusions in treatment diets (Table 3).

The effects of substituting CS and AH with MG silage on nutrient digestibility is presented in Table 4. Relative to the CON diet, the apparent total tract digestibility of DM was higher ($p<0.05$) in cows fed the MAS-50 diet and tended to increase ($p<0.08$) in cows fed the MAS-16 and MAS-33

Table 4: Effects of substituting corn silage and alfalfa hay with master graze silage on apparent total tract digestibility of nutrients in treatment diets

	Diet					
Item	CON	MAS-16	MAS-33	MAS-50	MSE	p-value
Dry matter	63.5^{b}	65.9^{ab}	66.0^{ab}	68.0^{a}	1.125	0.04
Organic matter	67.1^{b}	66.8^{b}	69.2^{ab}	71.7^{a}	1.165	0.02
Neutral detergent fiber	47.7^{c}	53.4^{b}	55.4^{b}	60.3^{a}	1.480	0.01
Crude protein	61.5^{b}	62.8^{ab}	62.8^{ab}	64.8^{a}	1.425	0.03

CON: Control diet, MAS-16: Control diet with 16% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), MAS-33: Control diet with 33% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), MAS-50: Control diet with 50% master graze silage as a replacement of corn silage and of alfalfa hay (DM basis), Values within rows with different superscripts are statistically different at $p<0.05$

diets. Similarly, the apparent total tract digestibility of OM was higher ($p<0.05$) in cows fed the MAS-50 diet and tended to increase ($p<0.11$) in cows fed the MAS-33, in comparison to the CON diet. The apparent digestibility of NDF was higher ($p<0.01$) in cows fed the MAS-50 diet than in cows fed the MAS-16 or MAS-33 diet and all were higher ($p<0.05$) than the cows fed the CON diet. Lastly, the apparent total tract digestibility of CP was higher ($p<0.05$) in cows fed the MAS-50 diet in comparison to cows fed the CON diet.

DISCUSSION

The DM content of the CON diet was higher than the treatment diets due to the DM content of the AH. Additionally, because the DM content for MG (17.5%) was lower than that of CS (27.4%), the DM content decreased as the percentage of MG silage in treatment diets increased. Dann *et al.* (2008) and Grant *et al.* (1995) also reported lower DM content in BMR sorghum-Sudan grass silage or sorghum silage than CS. The observed decrease in diets CP content with MG silage substitution is due to lower CP content in MG silage than anticipated (6.0 vs. 8.0%). The increase in the dietary NDF and ADF content with the inclusion of MG silage was expected, as NDF and ADF content for MG silage (69.1 and 43.02%) was higher than that of CS (47.4%, 29.04). The decrease in diet starch content was also expected as starch content of MG (2.11%) was lower than that of CS (24.23%) Other studies (Bernard *et al.*, 2002; Dann *et al.*, 2008) have also reported higher NDF and lower starch contents when CS in diets was substituted with sorghum or ryegrass silages.

The DMI in the current study was not affected by the treatment diets. The effect of replacing CS with other forage silages on DMI has not been consistent. Bernard *et al.* (2002) and Oliver *et al.* (2004) reported no differences in DMI when CS was replaced with ryegrass silage or sorghum silage. However, Lusk *et al.* (1984) reported a higher DMI with CS than BMR-12 sorghum in both dairy heifers and lactating dairy cows. Lance *et al.* (1964) and Nordquist and Rumery (1967) also observed a higher DMI of the CS diet than the sorghum silage diets. Dann *et al.* (2008) and Grant *et al.* (1995) also reported higher DMI with cows fed CS compared to BMR sorghum-Sudan grass silage or BMR sorghum silage. Studies that reported higher DMI with the CS diets had also reported higher digestibility with the CS diets. In the current study, the apparent DM and OM digestibility of treatment diets were higher than that of the CON diet and may explain the lack of effects on DMI.

Milk yield in the current study was not affected by the treatment diets in comparison to the CON diet, presumably because cows were in mid-lactation and their energy needs were being met. Other studies (Lusk *et al.*, 1984; Grant *et al.*, 1995; Oliver *et al.*, 2004; Colombini *et al.*, 2010) have also reported no differences in milk yield between cows fed CS or BMR-sorghum silage. However, milk yield was increased when ryegrass silage (Bernard *et al.*, 2002) and BMR-sorghum silage (Dann *et al.*, 2008) replaced CS in cows diet. Oba and Allen (1999) also reported higher milk yield with cows fed the BMR CS in comparison to the cows fed the normal CS. The studies that reported higher milk yield with BMR sorghum or BMR CS had also reported higher DMI. In the current study, DMI was not affected by treatment diets and may also explain the lack of effects on milk yield.

In the current study there was no effect of treatment on the cow's milk fat content or fat yield. Lusk *et al.* (1984), Dann *et al.* (2008) and Colombini *et al.* (2010) also reported no differences in milk fat content or yield when the CS in cow's diets was replaced by BMR sorghum silage. In contrast, Grant *et al.* (1995) and Oliver *et al.* (2004) observed that milk fat content was highest in cows fed the CS diet and the BMR sorghum diet but lowest in cows fed the normal sorghum diet. Likewise, in a study done by Aydin *et al.* (1999), milk fat content was higher in cows fed the BMR sorghum silage diet than cows fed the normal sorghum silage diet. Miron *et al.* (2007) reported higher milk fat content and yield in cows fed normal and BMR sorghum silage diets in comparison to the cows fed the CS diet. The discrepancies among studies could be attributed to the differences in diet composition, forage quality, stage of lactation and feed intake.

The treatment diets in the current study had also no effect on milk protein content and protein yield. Lusk *et al.* (1984), Oliver *et al.* (2004) and Colombini *et al.* (2010) also reported no differences in milk protein content or yield when cows were fed either CS or BMR sorghum silage. However, in other studies higher milk protein content was reported in cows fed CS diets in comparison to cows fed BMR sorghum silage diets (Grant *et al.*, 1995; Aydin *et al.*, 1999; Miron *et al.*, 2007) or BMR sorghum-Sudan grass silage (Dann *et al.*, 2008). Milk lactose content was higher in the cows fed the MAS-33 and MAS-50 diets, however, the increase in milk lactose content was marginal and most likely does not represent a biological difference. Grant *et al.* (1995) also reported higher milk lactose content in cows fed the BMR sorghum diet in comparison to the cows fed the normal sorghum diet. However, most studies reported no effects of replacing CS with sorghum silage on milk lactose content (Aydin *et al.*, 1999; Oliver *et al.*, 2004; Miron *et al.*, 2007; Dann *et al.*, 2008).

The apparent digestibility of DM and OM of treatment diets in this study were improved with the feeding of MG silage, particularly when MG silage replaced one-half of the forages in the cow's diet. Lusk *et al.* (1984) and Oliver *et al.* (2004) also reported higher DM digestibility for BMR sorghum silage than normal sorghum. In contrast to the current study, Bernard *et al.* (2002) and Dann *et al.* (2008) reported higher DM digestibility for CS diets in comparison to the ryegrass silage or BMR sorghum-Sudan grass silage diets, respectively. Despite the higher starch content for the CS (24%) relative to the MG silage (2%) and the greater NDF content for the MG silage (69%) relative to the AH (57%), the apparent DM digestibility was still higher with the MG silage diets suggesting that the nutrients (mostly NDF) in MG silage are highly digestible. Because of the lack of differences in DMI among treatment diets in this study, the differences in DM and OM digestibility were unlikely caused by alternation in rumen passage rate or pH.

The apparent digestibility of dietary NDF increased with the inclusion of the MG silage and the increase in dietary NDF digestibility was proportional to the MG silage inclusion level. Oba and Allen (1999) reported that the NDF digestibility was higher for the BMR CS diet in comparison to the normal CS diet. The NDF digestibility was also higher for BMR sorghum silage diet than the normal sorghum (Grant *et al.*, 1995; Aydin *et al.*, 1999; Oliver *et al.*, 2004). In contrast, Dann *et al.* (2008) reported no differences in NDF digestibility between cows fed CS or BMR sorghum-Sudan grass silage. Despite the increase in dietary NDF content with the inclusion of MG silage in the diets, the apparent NDF digestibihty was still higher for the MG diets suggesting that the fiber (NDF) in the MG silage is more digestible than that of CS or AH. The higher digestibility of DM, OM and NDF seen with the inclusion of MG silage may be also attributed in part to the higher apparent CP digestibility for the MG silage. Higher dietary CP digestibility may have resulted in more nitrogen being supplied to rumen microbes, cellulolytic bacteria in particular and therefore higher microbial activity and nutrient digestion in the rumen. Although, dietary CP digestibility was higher when ryegrass silage replaced CS in cow's diet, DM digestibility and NDF digestibility were still higher with the CS diet (Bernard *et al.*, 2002). Other studies, however, have reported either no changes (Oliver *et al.*, 2004) or increases (Lusk *et al.*, 1984; Dann *et al.*, 2008) in dietary CP digestibility with the CS diets in comparison to the BMR sorghum silage or BMR sorghum-Sudan grass silage diets.

CONCLUSION

The inclusion of MG silage in a lactating dairy cow diet did not affect cows feed intake, milk yield or milk composition. On the other hand, the inclusion of MG silage in the treatment diets improved the apparent total tract digestibility of DM, OM, NDF and CP. The MG silage may replace up to 50% of dietary corn silage-alfalfa hay mix in dairy cow rations without any adverse effect on cow performance.

REFERENCES

AOAC, 2000. Official Methods of Analysis. 17th Edn., Association of Official Analytical Chemistry, Arlington, Virginia, USA.

Aydin, G., R.J. Grant and J. Rear, 1999. Brown midrib sorghum in diets for lactating dairy cows. J. Dairy Sci., 82: 2127-2135.

Bernard, J.K., J.W. West and D.S. Trammell, 2002. Effect of replacing corn silage with annual ryegrass silage on nutrient digestibility, intake and milk yield for lactating dairy cows. J. Dairy Sci., 85: 2277-2282.

Cherney, J.H., D.J.R. Cherney, D.E. Akin, J.D. Axtell, 1991. Potential of Brown-Midrib, Low-Lignin Mutants for Improving Forage Quality. In: Advances in Agronomy, Sparks, D.L. (Ed.). Vol. 46. Academic Press, London, UK., ISBN-13: 9780120007462, pp: 157-198.

Colombini, S., L. Rapetti, D. Colombo, G. Galassi and G.M. Crovetto, 2010. Brown midrib forage sorghum silage for the dairy cow: Nutritive value and comparison with corn silage in the diet. Ital. J. Anim. Sci., 9: 273-277.

Dann, H.M., R.J. Grant, K.W. Cotanch, E.D. Thomas, C.S. Ballard and R. Rice, 2008. Comparison of brown midrib sorghum-sudangrass with corn silage on lactational performance and nutrient digestibility in Holstein dairy cows. J. Dairy Sci., 91: 663-672.

Gerhardt, R.L., J.O. Fritz, K.J. Moore and E.H. Jaster, 1994. Digestion kinetics and composition of normal and brown midrib sorghum morphological components. Crop Sci., 34: 1353-1361.

Grant, R.J., S.G. Haddad, K.J. Moore and J.F. Pedersen, 1995. Brown midrib sorghum silage for midlactation dairy cows. J. Dairy Sci., 78: 1970-1980.

Lance, R.D., D.C. Foss, C.R. Krueger, B.R. Baumgard and R.P. Niedermeier, 1964. Evaluation of corn and sorghum silages on the basis of milk production and digestibility. J. Dairy Sci., 47: 254-257.

Lusk, J.W., P.K. Karau, D.O. Balogu and L.M. Gourley, 1984. Brown midrib sorghum or corn silage for milk production. J. Dairy Sci., 67: 1739-1744.

Miron, J., E. Zuckerman, G. Adin, R. Solomon and E. Shoshani *et al*., 2007. Comparison of two forage sorghum varieties with corn and the effect of feeding their silages on eating behavior and lactation performance of dairy cows. Anim. Feed Sci. Technol., 139: 23-39.

NRC, 2001. Nutrient Requirements of Dairy Cattle. 7th Edn., National Academy of Sciences, Washington, DC., USA.

Nordquist, P.T. and M.G.A. Rumery, 1967. Corn and sorghum silage for lactating dairy cows. J. Dairy Sci., 50: 1255-1261.

Oba, M. and M.S. Allen, 1999. Effects of brown midrib 3 mutation in corn silage on dry matter intake and productivity of high yielding dairy cows. J. Dairy Sci., 82: 135-142.

Oba, M. and M.S. Allen, 2000. Effects of brown midrib 3 mutation in corn silage on productivity of dairy cows fed two concentrations of dietary neutral detergent fiber: 1. Feeding behavior and nutrient utilization. J. Dairy Sci., 83: 1333-1341.

Oliver, A.L., R.J. Grant, J.F. Pedersen and J. Rear, 2004. Comparison of brown midrib-6 and -18 forage sorghum with conventional sorghum and corn silage in diets of lactating dairy cows. J. Dairy Sci., 87: 637-644.

SAS/STAT, 2010. Software: Changes and Enhancements Through Release 9.2. SAS Institute Inc., Cary, NC.

USDA, 2012. Crop production 2011 summary. http://usda01.library.cornell.edu/usda/current/CropProdSu/CropProdSu-01-12-2012.pdf

Van Keulen, J. and B.A. Young, 1977. Evaluation of acid-insoluble ash as a natural marker in ruminant digestibility studies. J. Anim. Sci., 44: 282-287.

Van Soest, P.J., J.B. Robertson and B.A. Lewis, 1991. Methods for dietary fiber, neutral detergent fiber and nonstarch polysaccharides in relation to animal nutrition. J. Dairy Sci., 74: 3583-3597.

Vogel, K.P. and H.J.G. Jung, 2001. Genetic modification of herbaceous plants for feed and fuel. Crit. Rev. Plant Sci., 20: 15-49.