EFFECT OF RYEGRASS SILAGE DRY MATTER CONTENT ON THE PERFORMANCE OF LACTATING HOLSTEIN COWS

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ABSTRACT

Twenty-four lactating Holstein cows were used in a 6 wk randomized block design trial to determine the effect of DM content of annual ryegrass silage on intake and performance. The first 2-wk of the trial was used for standardization and all cows were fed a basal diet. At the end of the preliminary period, cows were blocked by parity and randomly assigned within block to one of two treatments for the following 4 wk. Treatments included annual ryegrass silage wilted to approximately 39 or 53% DM. Diets were fed once daily behind Calan doors and cows were milked twice daily. The chemical composition of the ryegrass silages was similar and fermentation measures were within normal ranges indicating that both silages were well fermented. There were no differences in DMI, yield of milk or components, or concentration of components among treatments. Dairy efficiency (kg energy corrected milk/kg DMI) tended to be higher for cows fed the low DM ryegrass silage (1.46) compared with that observed for cows fed the high DM ryegrass silage (1.35). The improved efficiency is a result of numerically higher DMI and similar milk yield. These results indicate that wilting annual ryegrass beyond 39% DM does not improve milk yield or composition.

INTRODUCTION

Ryegrass is a winter annual that produces high quality forage which can be grazed, or harvested as green chop, silage, or hay. Previous research at our location indicates that ryegrass silage can be economically fed in combination with either corn or sorghum silage to maintain high levels of milk production (Bernard et al., 2001, 2002). Ideally ryegrass should be wilted before chopping for silage, but weather conditions are often less than ideal for wilting. Harvesting ryegrass without wilting increases runoff of effluent and loss of digestible nutrients (Kung, 2002). Also, forage ensilaged with high moisture concentrations has lower aerobic fermentation (McDonald et al. 1991) resulting in lower quality silage that may have reduced palatability and nutrient digestibility and would be more susceptible to secondary fermentation which would be a greater problem during the summer in the hot, humid Southeast.

The effect of dry matter content of annual ryegrass on dry matter intake and animal performance has not been addressed. When the DM content of ensiled forage is greater than 45%, it is difficult to pack the material adequately in bunker or pit silos, which results in excessive heating and mold formation. The objective of this trial is to collect data to determine the effect ryegrass silage DM content has on intake and performance of lactating dairy cows.

MATERIALS AND METHODS

Annual ryegrass (Big Daddy, Southern States Cooperative, Inc., Richmond, VA) was planted in October, 2006 and managed according to UGA fertility recommendations. The ryegrass was irrigated with dairy waste water to meet P and K requirements. Additional N was provided by commercial fertilizer. The annual ryegrass was mown in late March while in the vegetative stage of maturity and allowed to wilt to 39% or 53% DM before chopping. Every other windrow was harvested to minimize any potential variation in quality. The chopped ryegrass was packed into 2.4 m plastic silage bags and allowed to ferment before beginning the feeding trial approximately 6 mo later. All forages were treated with a commercial microbial inoculant (Bitol™ Buchneri 40788, Lallemand Animal Nutrition, Milwaukee, WI) at harvest.

A 6-wk completely randomized block trial utilizing 24 lactating Holstein cows (average 141 DIM and 37.9 kg/d milk) was conducted at the Tifton Dairy Research Center. All procedures were approved by the University of Georgia Institutional Animal Care and Use Committee. Before beginning the trial, the cows were trained to eat behind Calan gates (American Calan, Northwood, NH). Once trained, all cows were fed a basal diet during the 2-wk preliminary period during which time performance data were collected for use as a covariate in the statistical analysis. At the end of the preliminary period, cows were blocked by lactation number, milk yield, and DIM. Cows within each block were assigned randomly to one of two treatments by parity for 4-wk (experimental period). Treatments included ryegrass harvested at two DM concentrations. Experimental diets contained approximately 50% forage and were formulated to provide similar proportions of each ingredient (Table 1). Diets were fed once daily and feed pushed up in the individual feed boxes 2 to 3 times each day.

During both the preliminary and experimental periods, the amount of feed offered and refused was recorded daily. Cows were milked twice daily and milk weights recorded electronically at each milking (Alpro, Delaval Inc., Kansas City, MO) and totaled each day. Milk samples were collected from two consecutive milkings each week for analyses of milk fat and protein concentrations. The BW of each cow was recorded on three consecutive days immediately after the pm milking at the end of the preliminary and experimental period. Samples of all forages and experimental diets were collected 3-d each week and composited for chemical analyses. Samples were dried in a force air oven for 60 h at 55ºC. Samples were ground to pass through a 6-mm screen using a Wiley Mill (Arthur B. Thomas, Philadelphia, PA) and then split into two subsamples. The second subsample was ground to pass through a 1-mm screen. Forages were analyzed for DM, ash, CP (AOAC, 1990) NDF, ADF and *in situ* DM and NDF 30 h digestibility (Van Soest et al., 1991).

Data were subjected to covariate analysis of variance using PROC MIXED (SAS Inst. Inc., Cary NC). The model included covariate, block, treatment, week, and the appropriate interactions. Data from the preliminary period were used as a covariate. Cow within treatment was included as a random effect and week as a repeated effect.

RESULTS AND DISCUSSION

The chemical content of the low and high DM ryegrass silages was similar (Table 2). The actual DM values for the low and high DM ryegrass silages ranged from 36 to 41% and from 42 to 54%, respectively, throughout the trial and averaged 38.8 and 53.2% for low and high DM silage, respectively. The 30 h DM and NDF *in situ* digestibility of the annual ryegrass silage was very high which is typically for this forage harvested at the vegetative stage of maturity. The fermentation profile of the low and high DM silages was similar and within normal ranges. The composition of the corn silage was typical for a high grain variety and was preserved well based on the fermentation profile.

The DM content of the two experimental silages did not have any effect on DMI, milk fat and protein concentrations or yield (Table 3). There was a tendency for higher milk yield for the diets containing the annual ryegrass silage harvested at the higher DM content throughout the trial; however, there was an interaction of treatment by week (P = 0.055). Cows fed the high DM ryegrass silage tended to have higher milk yield during wks 1 and 2 whereas milk yield was equal during wk 3 (Figure 1). During wk 4 milk yield was numerically higher for the cows fed the annual ryegrass harvested at the higher DM. No differences were observed in either energy-corrected milk (ECM) yield or dairy efficiency (kg ECM/kg DMI, Table 3) since there were no differences in DMI or component yield.

CONCLUSIONS

Based on chemical analysis of the two silages, it does not appear that wilting the ryegrass to approximately 50% reduced the fermentability of the annual ryegrass compared to that harvest at 38% DM when stored in plastic silage bags. The results of the lactation trial suggest that additional wilting of ryegrass silage beyond 40% DM tends to support higher milk yield without does not provide any additional benefit based on milk yield and composition. However, the higher DM silage does appear to stimulate higher DMI of lactating Holstein cows in a time wise manner which reduced dairy efficiency. The implications of this are possibly increased feed cost if the trend held and need for additional forage to feed the herd.

ACKNOWLEDGMENTS

Partial funding for this research was provided through the Florida Milk Check-Off Program. The authors extend their appreciation to Jessica Daniel for assistance in feeding and sample collection and to Vic Cornet and the staff of the Tifton Dairy Research Center for milking and animal care.

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Table 1. Ingredient and chemical composition of experimental diets containing annual ryegrass silage harvested with either low or high DM concentrations.

	Treatment	
	Low DM	High DM
Ingredient	% of DM	
Corn silage	30.0	30.0
Low DM annual ryegrass silage	22.0	
High DM annual ryegrass silage		22.0
Ground corn	14.0	14.0
Brewers grains, wet	13.4	13.4
Whole cottonseed	8.0	8.0
Soybean meal, 48% CP	5.4	5.4
Calcium salts of long chain fatty acids	2.0	2.0
Prolak[1]	2.7	2.7
Vitamin and mineral premix[2]	2.5	2.5
Chemical composition[3]		
CP	17.5	17.9
RUP	40.4	40.8
RDP	59.5	59.2
NDF	33.5	34.1
ADF	19.5	19.5
NFC	36.2	35.3
Starch	23.3	23.4
Ash	8.3	8.3
	Mcal/kg	
NE_l	1.79	1.79

[1]H. J. Baker & Bros., Inc., Stamford, CT.
[2]The vitamin and mineral premix contained (as fed basis) 0.7% sodium bicarbonate, 0.2% potassium magnesium sulfate, 0.5% limestone, 0.2% magnesium oxide, 0.2% salt, 0.04% Availa-4 (Zinpro Corporation, MN), 0.24 yeast culture, and 0.46% trace mineral and rumensin.
[3]Chemical composition is based on forage analysis and standard values for the remaining ingredients using CMP -Dairy (Version 3.0.8).

Table 2. Chemical composition of forages used in diets (Mean ± SD).

	Annual ryegrass silage		
	Low DM	High DM	Corn silage
	%		
DM	38.8 ± 3.1	53.2 ± 2.5	37.6 ± 3.9
	% of DM		
CP	12.5 ± 0.3	14.4 ± 0.1	8.8 ± 0.3
NDF	41.7 ± 0.4	44.4 ± 1.9	39.1 ± 0.6
ADF	27.9 ± 0.9	27.9 ± 0.1	20.3 ± 1.3
Lignin	3.3 ± 0.6	4.0 ± 0.4	2.5 ± 0.1
Starch	0.6 ± 0.2	1.0 ± 0.1	34.3 ± 1.3
Fat	3.9 ± 0.1	5.0 ± 1.2	3.6 ± 0.3
Ash	12.5 ± 0.6	12.4 ± 0.8	3.8 ± 0.3
	%		
IDMD, 30 h	88.0 ± 3.0	85.0 ± 3.0	73.9 ± 2.1
INDFD, 30 h	76.9 ± 2.0	73.0 ± 5.0	40.0 ± 5.4
pH	4.25 ± 0.11	4.25 ± 0.00	3.90 ± 0.11
	meq/100 gm		
Lactic acid	8.40 ± 1.28	9.25 ± 0.64	4.78 ± 0.22
	% of DM		
Acetic acid	3.26 ± 0.52	1.83 ± 0.31	1.35 ± 0.11
Propionic acid	< 0.01	< 0.01	< 0.01
Iso-butyric acid	< 0.01	< 0.01	< 0.01
Butyric acid	< 0.01	< 0.01	< 0.01
Total VFA	11.66 ± 1.77	11.08 ± 0.33	6.13 ± 0.28

Table 3. Dry matter intake and performance of lactating Holstein cows fed diets containing low or high DM annual ryegrass silage

	Annual ryegrass silage			
	Low DM	High DM	SE	P
DMI, kg/d	25.9	27.1	0.8	0.33
Milk, kg/d	36.6	38.1	0.6	0.09
Fat, %	3.85	3.59	0.19	0.36
Fat, kg/d	1.41	1.37	0.06	0.80
Protein, %	3.17	3.03	0.13	0.33
Protein, kg/d	1.11	1.05	0.07	0.53
ECM, kg/d[1]	39.0	38.9	1.0	0.68
Efficiency	1.50	1.43	0.07	0.68

[1]Energy corrected milk yield = (0.327 x kg milk) + (12.86 x kg fat) + (7.65 x kg protein).

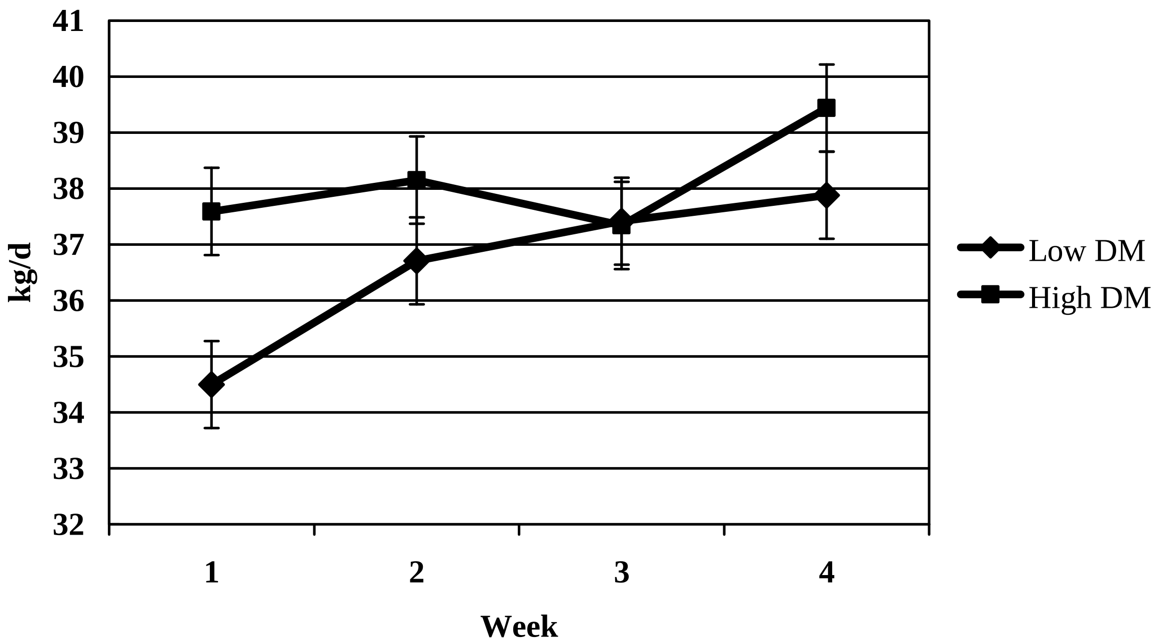

Figure 1. Change in milk yield of cows fed diets containing low or high DM ryegrass silage (P = 0.55).