Effects of feeding two different types of sorghum-sudangrass silage based diets on nutrient intake and digestibility and growth of Holstein dairy heifers

Lingyan Li[1], Nancy Esser[2], Robin Ogden[3], Wayne Coblentz[3], Matt Akins[4]

[1]College of Animal Science and Veterinary Medicine, Daqing, Heilongjiang, China; [2]University of Wisconsin- Madison Marshfield Agricultural Research Station, Marshfield, WI

[3]US Dairy Forage Research Center, Marshfield, WI; [4]Department of Dairy Science, University of Wisconsin-Madison, Madison, WI

ADSA 2019-T88

DEPARTMENT OF DAIRY SCIENCE
University of Wisconsin-Madison

USDA

BACKGROUND

Bred and pregnant dairy heifer require lower diet energy contents than younger heifers, but feeding lower energy diets can be a challenge for some producers that primarily harvest high quality forages. Sorghum forages can be less expensive to grow, and typically have lower energy density and greater concentrations of fiber when harvested at later maturities; therefore they may be very suitable for replacement dairy heifers. Previous research at our facility with other high fiber, lower energy forages has shown reduced DM and energy intake leading to more optimal growth for pregnant dairy heifers.

OBJECTIVES

To evaluate feed intake and growth of bred/pregnant dairy heifers fed diets containing either photoperiod sensitive (PSS) or conventional (CSS) sorghum-sudangrass silage compared to a control diet including low-quality grass hay.

MATERIALS & METHODS

Forage Production

- Conventional (CSS; AS5201; Alta Seeds) and Photoperiod Sensitive (PSS) (PSS; Mega Green; Walter Moss Seeds) sorghum-sudangrass seeded at 45 kg seed/ha
- Cut and conditioned (9/22/2017) and harvested as silage (9/25/2017)
- Yields were 6.9 tons DM/ha for CSS and 5.9 tons DM/ha for PSS

Animal Feeding and Measurements

- 72 bred or pregnant Holstein heifers (16 to 18 mos) were blocked by weight (low, medium, high) and randomly allocated to pens of 8 heifers with a total of 9 pens and 3 pens per treatment
- Treatment diets were randomly allocated to pens within each block
- Diet Treatments:
  - CSS and PSS included the respective SS silage and alfalfa silage
  - Control consisted of alfalfa silage, corn silage and low-quality grass hay (primarily reed canary grass)
  - Balanced for energy and protein (60% TDN and 13-14% CP, DM)
- Diets fed for 12 weeks with orts measured to calculate feed intakes
- Weights and measures taken 3 days at the start and end of study
- Nutrient digestibility (DM, NDF, N) measured using fecal grab samples at 4 time-points in wk 5 and 10. 240 h in-situ iNDF used as an internal marker
- Diet sorting measured (wk 4 and 9) using bunk samples taken at 4 time-points (1400, 1700, 2000, 2300) with 1 sample time/pen/day, in addition to ort and initial TMR samples. Bunk and ort samples were evaluated for particle size distribution and compared to the original TMR particle size distribution.
- Data were analyzed as a randomized complete block design with weight block as a fixed effect and sampling week (digestibilities and sorting) as a repeated measure

RESULTS

Table 1. Diet and nutrient composition

Item	Diet			Nutrient composition (DM basis)				
	Control	CSS	PSS	CSS silage	PSS silage	Corn silage	Chopped grass hay	Alfalfa silage
Ingredient, % of DM								
SS silage	0	48.0	0					
Corn silage	16.8	5.0	5.0					
Chopped hay	25.8	0	0					
Alfalfa silage	56.3	46.0	46.0					
Urea	1.0	1.0	1.0					
Nutrient composition								
DM, % as fed	48.8	40.1	39.0	42.1	40.7	40.9	94.1	50.0
CP, % DM	14.3	12.8	13.1	6.82	6.98	6.45	8.42	13.7
NDF, % DM	47.9	55.4	55.2	62.9	58.7	35.6	61.9	48.6
NDFD, % of NDF	54.2	61.2	58.6	49.2	45.6	43.4	36.6	49.7
Ash,% DM	8.84	9.29	9.73	7.84	7.99	3.38	7.21	9.08
TDN, %	61.1	61.1	59.3	53.7	53.5	71.8	48.2	60.3
ME, Mcal/kg	2.37	2.35	2.29	1.94	1.94	2.75	2.34	1.87

Picture 1. Photoperiod sensitive SS (left) and conventional SS (right) prior to cutting (1.5-2 m height)

Picture 2. Long particles in SS diet orts due to longer stem particles in SS silages

Table 2. Nutrient intakes, digestibility, and growth measures

Item	Diet			SEM	Contrast[1] (*P*=)	
	Control	CSS	PSS		1	2
Nutrient intake						
DM, kg/d	10.90	9.27	9.01	0.14	<0.01	0.26
CP, kg/d	1.51	1.17	1.16	0.02	<0.01	0.92
NDF, kg/d	5.22	5.16	5.01	0.07	0.21	0.22
NDF as % of BW	1.04	1.04	1.01	0.01	0.58	0.13
TDN, kg/d	6.68	5.71	5.38	0.09	<0.01	0.05
ME, Mcal/d	25.9	22.0	20.8	0.34	<0.01	0.02
Nutrient Digestibility						
DM	58.6	60.4	59.1	0.45	0.09	0.10
NDF	54.6	58.5	55.2	0.94	0.07	0.04
Apparent N	68.4	67.8	67.0	0.70	0.16	0.30
Growth Measures						
Daily gain, kg/d	1.11	0.89	0.94	0.04	0.02	0.46
Hip height gain, cm	4.19	4.05	2.95	0.73	0.48	0.34
BCS gain, units	0.32	0.31	0.34	0.06	0.95	0.73
Efficiency (DMI/ADG)	9.93	10.43	9.62	0.29	0.80	0.12

[1]Contrasts: 1.Control versus sorghum silage diets (mean of CSS and PSS); 2.CSS versus PSS.

Table 3. Sorting factors for diets over time

Sorting factor[1]	Initial TMR, %	Sampling time				
		1400h	1700 h	2000 h	2300 h	Orts
Large particles (>19 mm)						
Control	16.1±0.68	1.26	1.33	1.64	1.55	1.86
CSS	18.1±0.78	1.16	1.23	2.08	2.43	3.94
PSS	20.0±0.88	1.11	1.51	1.88	3.05	3.09
SEM				0.20		
Contrast[2](*P* > *F*)						
1		0.60	0.86	0.20	<0.01	<0.01
2		0.86	0.35	0.50	0.05	0.01
Short particles (4-8 mm)						
Control	18.8±0.62	1.05	1.00	0.86	0.90	0.80
CSS	18.7±0.94	1.08	1.03	0.88	0.80	0.50
PSS	18.6±1.26	1.03	0.99	0.83	0.47	0.51
SEM				0.05		
Contrast(*P* > *F*)						
1		0.82	0.98	0.86	<0.01	<0.01
2		0.43	0.58	0.43	<0.01	0.92

[1]Sorting factor = % of sample at particle size / % of initial TMR at corresponding particle size

[2]Contrasts: 1.Control versus mean of CSS and PSS. 2.CSS versus PSS

SUMMARY

Diet Composition and Nutrient Intakes

- Both SS silage diets had increased NDF% compared to the Control diet even with use of a low-quality grass hay
- DM intake was reduced ($P < 0.01$) for heifers fed CSS or PSS relative to Control due to the greater diet NDF content
- NDF intake amounts and as % of BW were similar across treatments with NDF intake as a % of BW close to 1.0%
- Energy, CP, and mineral intakes were greater for heifers fed Control due to its greater DM intake

Growth Measures and Efficiency

- Daily gains for heifers fed CSS or PSS were lower than Control (P = 0.02), but were close to desired growth goal of 0.8-1 kg/d for Holsteins depending on mature body size
- No differences were found for hip height, heart girth, or body condition gains
- Feed efficiency was similar across diets at approximately 10 kg intake/kg gain

Diet Sorting

- Heifers aggressively sorted against long particles for all diets, but more so for the SS diets. By 2300 h, the SS diets had greater % long particles in the diet than Control ($P < 0.01$)
- Heifers sorted for medium (not shown), short, and fine (not shown) particles for all treatments; but more aggressively for the SS diets due to the longer SS stem particles in the TMR.

CONCLUSIONS

- Use of a SS silage with higher NDF content can control DM intakes and growth of post-bred heifers more so than a diet balanced for similar energy but lower NDF content.
- Diet sorting can be an issue when harvesting SS due to the long stems so adjustment of harvesting equipment for a shorter chop length will help limit sorting

ACKNOWLEDGMENTS

- This project was partially supported by a Midwest Forage Association Research Grant and by the USDA National Institute of Food and Agriculture, Hatch project 1006557.
- The authors thank Scott Fischer, Jason Cavadini, Will Cordes and field and herd staff of the Marshfield ARS