Effects of bale feeder type, monensin supplementation, limit feeding, and hay ammoniation on hay waste, intake, and performance of beef cattle

J. D. Sparks, S. K. Linneen, and D. L. Lalman

STORY IN BREIF

This experiment was conducted to evaluate the effects of bale feeder type, monensin supplementation, limit feeding, and hay ammoniation on hay waste, net disappearance, and cow performance. Lactating Angus and Angus x Hereford cows (n =36; 1,164 ± 63 139 lb) were allotted by BW to one of two treatments. Treatment 1 (CONT); control included 24 h access to a ring feeder with low quality prairie hay and 2.5 lb/d of a cottonseed meal based supplement. Treatment 2 (LIMIT) included 6 h access to a modified cone feeder with ammoniated prairie hay and 1.75 lb/d of a wheat middlings and cottonseed meal based supplement with 200 mg/hd inclusion of monensin. Cattle were allotted to one of four previously grazed 3 acre paddocks equipped with a 40 x 25 ft^2 concrete pad. There was no difference in cow BW change between d 0 and off test. However, calves from cows receiving the LIMIT treatment gained less weight than those receiving the CONT treatment. Total hay waste was significantly reduced by the LIMIT treatment. Total waste was 295 and 106 lb for CONT and LIMIT treatments, respectively. CONT treatment wasted 21.9% of bale weight, compared to 7.3% for the LIMIT treatment. Net disappearance was significantly reduced by the LIMIT treatment. There was no economic benefit for the LIMIT treatment for the feeding period observed. However, if feeding period and hay price increase the combination of modified cone feeder, limit feeding, monensin supplementation, and hay ammoniation should result in a decrease in feeding cost without sacrificing cow performance.

Key Words: beef cattle, hay waste, feeder design, monensin, ammoniation

INTRODUCTION

Feeding hay to beef cattle in the Great Plains is a very common management practice. There have been several technologies or management strategies developed to increase efficiency of harvested forage utilization. These include, but are not limited to, hay feeder design, limiting access to hay, monensin supplementation, and hay ammoniation. Pasture and feed for cattle can account for over 60% of the costs of a cow-calf operation (Miller et al., 2007). For 101 northern plains beef herds hay cost averaged $152 per cow (Hughes, 2013). As input costs continue to rise, the ability to reduce feed costs by increasing hay feeding efficiency has the potential to greatly affect cow-calf profitability in the Great Plains. The purpose of this study was to determine hay disappearance, hay waste, and animal performance of a winter feeding system integrating these four underutilized technologies compared to a more conventional winter feeding system.

MATERIALS AND METHODS

This experiment was conducted at the Range Cow Research Center, North Range Unit, located approximately 28 mi west of Stillwater, OK. Thirty six lactating Angus and Angus x Hereford cows (1,164 ± 139 lb) were allotted by 12 h shrunk BW and assigned to one of two treatments.

Treatment 1 (CONT) included 24 h access to an open bottom steel ring feeder containing round bales of prairie hay (5.5% CP, 50% TDN) and 2.5 lb/d of a 38% CP cottonseed meal-based supplement. Treatment 2 (LIMIT) included limited access to a modified cone feeder containing ammoniated prairie hay (13.7% CP, 58% TDN) and 1.75 lb/d of a 20% CP wheat middlings and cottonseed meal based supplement with 200 mg/d per head inclusion of monensin (MON, Rumensin 90®; Elanco Animal Health; Greenfield, IN). Wire panels were placed around the concrete pads to allow access for 6 h daily; starting at 0800 h. Cattle were assigned to one of four pens measuring approximately three acres each with two pens per treatment. Each pen was previously grazed to remove standing forage and included a 40 x 25 ft^2 concrete pad. Sixty nine bales of prairie hay were ammoniated in September 2012. Inclusion of anhydrous ammonia was 2.5% of hay DM. Two waste collection periods were completed during the experiment. Prior to collection, concrete pads were cleared of hay and debris, and all hay remaining within the feeders was removed, weighed, and sampled. A fresh round bale was weighed, core sampled, and placed in each feeder. Hay waste was measured at 1300 h daily until 85% of the hay within each feeder was consumed. All hay outside of the feeders at the time of collection was considered waste. Waste was separated into wet and dry subgroups to account for differences in dry matter due to fecal and urine contamination. Cattle were weighed and allotted based on BW. The following day cattle were weighed again (d 0) and placed on treatment. BW and BCS (1 to 9 scale; Wagner et al., 1988) were recorded on d 0, d 32, and d 62. BW was taken on calves on d 0, d 32, and d 62. Cattle and calves were removed from treatments on d 62 and were comingled on pasture until a final weight was taken 7 d later to adjust for differences in fill between cattle receiving either treatment. On weigh d, cattle on the CONT treatments were moved at daylight and comingled with cattle in LIMIT pens where there was not access to hay until after the weigh period. This was done to minimize fill differences due to hay intake immediately prior to collecting weights. Data were analyzed using the MIXED procedure of SAS (SAS Inst., Inc., Cary, NC). Pen was considered the experimental unit and the model included treatment as a fixed effect. Tendencies were reported at 0.05 < P-Value ≤ 0.10.

RESULTS AND DISCUSSION

Diets were designed to meet protein requirements, and weight loss in lactating beef cattle consuming ad libitum low quality hay was expected. Cattle receiving both treatments lost BW, -71.6 and -86.1 lb for CONT and LIMIT treatments, respectively (P = 0.14; Table 1). The LIMIT treatment lost more BW (P = 0.01; Table 1) however, there was no difference in d 0-off test BW change (P = 0.14; Table 1) when fill was adjusted. There was no difference between treatments for d 0-62 BCS change (P = 0.17; Table 1). These results suggest that the LIMIT treatment maintained similar cow performance as the CONT treatment.

Table 1. Effect of bale feeder type, monensin supplementation, limit feeding, and hay ammoniation on cow body weight and body condition score, and calf performance

	Treatment[1]			
Item;	Control	Limit	SEM	*P*-value
Cow BW change, lb;				
d0-d62	-5.2	-68.0	10.19	0.01
d0-off test[2]	-71.6	-86.1	9.70	0.14
Cow BCS change;				
d0-d62	-0.13	-0.41	0.20	0.17
Calf BW change, lb;				
d0-d62	106.6	84.6	4.29	0.01
d0-off test	103.0	88.5	5.06	0.01

[1]Control = 2.5 lb of a 38% CP cottonseed meal based pellet (2.5 lb/d) with 0 mg/hd monensin, ad libitum access to prairie hay, open bottom steel ring feeder; Limit = 1.75 lb of a 20% cottonseed meal based pellet (1.0 lb/d) with 200 mg/head of monensin, 6 hours access to prairie hay, modified cone feeder.
[2]Off Test = Weight taken 7 days after completion of feeding to adjust for gut fill.

Calf BW was not different between treatments on d 0 ($P = 0.96$) or off test ($P = 0.47$). Calves receiving the LIMIT treatment gained less BW between d 0-62 ($P = 0.01$; Table 1) and d 0-off test ($P = 0.01$). Calves receiving the LIMIT treatment gained 14.5 lb less than calves receiving the CONT treatment.

The LIMIT treatment resulted in less wet waste, dry waste and total waste ($P \leq 0.01$; Table 2). Total waste was decreased ($P < 0.01$) in the LIMIT treatment by 188 lb per bale fed. Total waste in the CONT treatment was 295 lb, compared to only 107 lb of waste in the LIMIT treatment. Cattle receiving the CONT treatment wasted 21.9% of bale weight while cattle receiving the LIMIT treatment wasted only 7.3% of bale weight.

Table 2. Effect of bale feeder type, monensin supplementation, limit feeding, and hay ammoniation on hay waste

	Treatment[1]			
Item, lb	Control	Limit	SEM	*P*-value
Hay fed	1360	1480	62.09	0.10
Orts	124	288	49.36	0.02
Wet waste	152	66	20.74	0.01
Dry waste	143	41	17.42	0.01
Total waste	295	107	14.81	0.01
Bale weight Wasted, %	21.86	7.25	1.85	0.01

[1]Control = 2.5 lb of a 38% CP cottonseed meal based pellet (2.5 lb/d) with 0 mg/hd monensin, ad libitum access to prairie hay, open bottom steel ring feeder; Limit = 1.75 lb of a 20% cottonseed meal based pellet (1.0 lb/d) with 200 mg/head of monensin, 6 hours access to prairie hay, modified cone feeder.

There was a large decrease (*P* < 0.01; Table 3) in hay fed between treatments. The cattle receiving the LIMIT treatment were fed 5,279 lb less per pen than cows receiving the CONT treatment. Net disappearance was measured as hay fed minus orts. Net disappearance between treatments was significant (*P* < 0.01). The LIMIT treatment resulted in a decrease in net disappearance per day of 13.3 lb per cow. This resulted in a total hay savings of 6,584 lb per pen over the 62 d experiment.

Table 3. Effect of bale feeder type, monensin supplementation, limit feeding, and hay ammoniation on net disappearance

	Treatment[1]			
Item, kg	Control	Limit	SEM	*P*-value
Hay fed	22,763	17,484	129.80	0.01
Orts	1,239	2,544	209.60	0.02
Net disappearance;				
Per pen	21,524	14,940	147.70	0.01
Per cow	2,690	1,867	18.46	0.01
Per cow/day	43.4	30.1	0.30	0.01

[1]Control = 2.5 lb of a 38% CP cottonseed meal based pellet (2.5 lb/d) with 0 mg/hd monensin, ad libitum access to prairie hay, open bottom steel ring feeder; Limit = 1.75 lb of a 20% cottonseed meal based pellet (1.0 lb/d) with 200 mg/head of monensin, 6 hours access to prairie hay, modified cone feeder.

Costs associated with each treatment are different due to differences in overhead cost and daily costs. Overhead costs for this study are referred to as bale feeder and fence costs. These costs are depreciated for five years for the bale feeder and three years for the fencing materials. The modified cone feeder in the LIMIT treatment costs $575, compared to $455 for the ring feeder. Additionally, calf weight gain was decreased, resulting in a loss of $21.73/hd due to lost revenue in calf sales at weaning. Overall, the cost/d of the CONT and LIMIT treatment was $2.86 and $2.88, respectively, per cow.

Table 4. Sensitivity of hay price and days fed on economics

	Cost of Hay, $ / Ton			
Item;	$ 50	$ 100	$ 150	$ 200
60 d feeding length				
Cont[1]	107	172	237	302
Limit[2]	129	174	219	264
80 d feeding length				
Cont	138	225	312	399
Limit	158	218	278	338
100 d feeding length				
Cont	170	279	387	496
Limit	187	262	337	391
120 d feeding length				
Cont	202	332	462	592
Limit	215	306	396	465

[1]Control = 2.5 lb of a 38% CP cottonseed meal based pellet (2.5 lb/d) with 0 mg/hd monensin, ad libitum access to prairie hay, open bottom steel ring feeder;
[2]Limit = 1.75 lb of a 20% cottonseed meal based pellet (1.0 lb/d) with 200 mg/head of monensin, 6 hours access to prairie hay, modified cone feeder.

The economic response to hay price and length of feeding period are in Table 4. The LIMIT treatment does show substantial economic benefit as hay price increases up to $200/ton and length of feeding approaches 120 d, resulting in $127 saving for the feeding period. With increased days per feeding period or increased hay prices this feeding system has the potential to be an economical alternative feeding system for lactating beef cows.

LITERATURE CITED

Hughes, H. 2013. Lower net returns expected for cowherds in 2013. http://beefmagazine.com/blog/lower-net-returns-expected-cowherds-2013 Accessed July 24, 2013.

Miller, A. J., D. B. Faulkner, R. K. Knipe, D. R. Strohbehn, D. F. Parrett, and L. L. Berger. 2007. Critical control points for profitability in the cow-calf enterprise. Prof. Anim. Sci. 17:95-302.

Wagner, J. J., K. S. Lusby, J. W. Oltjen, J. Rakestraw, R. P. Wettemann, and L. E. Walters. 1988. Carcass composition in mature Hereford cows: estimation and effect on daily metabolizable energy requirement during winter. J. Anim. Sci. 66:603-612