Bale grazing: Can different supplementation strategies enhance beef cattle performance under variable winter conditions?

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This study evaluated a molasses-based liquid, alfalfa hay, and corn DDGS as supplements for beef cattle bale grazing grass hay during winter conditions encountered in the northern Plains. Results showed that supplements such as alfalfa hay or molasses-based liquids are effective during mild winters but higher energy supplements such as corn DDGS are required in severely cold winters when cattle require extra energy to maintain or improve performance. Supplementation strategies should consider supplement effectiveness to meet protein and energy requirements, particularly in winter conditions such as those encountered in the northern Plains.

Summary

The 2016 National Academies of Sciences, Engineering, and Medicine (NASEM) model was used to assess the adequacy of a molasses-based liquid, alfalfa hay, and corn DDGS as supplements for beef cattle grazing grass hay grass during a severely cold winter, a moderately cold winter, and a mild winter. All supplementation strategies supplied adequate metabolizable protein (MP) for nonlactating beef cows in environmental conditions encountered. Grass hay did not provide adequate metabolizable energy (ME) to meet requirements across environmental conditions encountered. Molasses-based liquid and alfalfa hay provided adequate ME in a mild winter but not in a moderately cold or severely cold winter. Corn DDGS supplied ME in excess of cow requirements in all environmental conditions encountered. We concluded that alfalfa hay or molasses-based liquids may be utilized as supplements during mild winters. Supplementation with higher energy feeds such as corn DDGS is required during severe winters where cattle require extra ME to maintain or improve performance.

Introduction

Cattle in the northern Plains are normally kept in open dry lot pens in winter. Alternatively, dry lot use can be minimized by extending the grazing season through strategies such as bale grazing, swath grazing, stockpiling and grazing corn residue. Bale grazing means placing hay bales in a grid pattern on hayfields or pastures for grazing in the fall and winter (McGeough et al, 2018). Benefits of bale grazing include returning nutrients onto land and minimizing nutrient loss through runoff or leaching. More importantly, lower labor and input costs associated with extended grazing can decrease production costs and potentially enhance profitability of livestock production. Forages utilized for bale grazing are predominantly perennials, mainly grasses and grass-legume mixtures, although straw also may be utilized (McGeough et al, 2018). In situations where cattle are offered low-quality grass hay or straw, supplementation may be required to meet cattle nutrient requirements. Supplementation becomes especially critical during harsh winter conditions, such as those encountered in the northern Plains. Since extended grazing systems are predicated on lower winter feed costs relative to dry lot feeding, supplementation strategies selected for these systems should maintain cost savings while providing targeted amounts of required nutrients. Cost savings can be maintained through strategies that either reduce frequency of supplement delivery to cattle on pasture or eliminate pasture visits for supplementation purposes altogether.

For supplements such as corn DDGS, which have to be delivered to cattle on pasture, supplementation costs can be minimized by decreasing labor and equipment inputs by reducing frequency of supplementation (Wickersham et al., 2008). Less frequent supplement

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delivery often does not negatively impact animal performance and can decrease costs associated with supplementation. Pasture visits for supplementation purposes may be eliminated by supplying high-quality forage to complement low-quality forage or treating low-quality forage with molasses-based liquid supplements. Alfalfa hay has been utilized to complement cattle grazing low-quality pastures (Weder et al., 1999). Liquid supplements poured directly onto hay can reduce hay waste, improve hay storage and improve nutrient content of low-quality forage (Walker et al., 2013). Currently, there is limited information on strategies for supplementing cattle in extended grazing systems.

Experimental Procedures

Environmental temperatures (Table 1), feed composition (Table 2) and cow performance data (Table 3) were entered into the 2016 NASEM model to predict ME and MP requirements and supply of nonlactating beef cows during a severely cold winter (10°F), a moderately cold winter (16°F) and a mild winter (25°F). Cow performance data were obtained from a four-year bale grazing study that evaluated a molasses-based liquid, alfalfa hay, corn DDGS as supplements for cows bale grazing grass hay. Liquid supplementation involved pouring the molasses-based liquid supplement, Range-40 (QLF Inc., Dodgeville, WI), onto grass hay bales. Supplementing with alfalfa hay was accomplished by providing one bale of alfalfa hay for every three bales of grass hay fed during each feeding cycle. Corn DDGS was delivered twice weekly to cattle on pasture and fed in bunks to provide 4 lbs corn DDGS/head/day. Bale grazing duration averaged 67 days across the years and grazing generally commenced in mid-November of each year until January except in 2017 when grazing started earlier.

Table 1. Average monthly temperatures during bale grazing.

		Temperature (°F)				
Year	Duration	October	November	December	January	Mean
2016	Nov. 4 - Jan. 12	-	29.1	6.8	-5.6	10.1
2017	Oct. 24 - Dec. 28	36.1	27.0	10.9	-	24.8
2018	Nov. 5 - Jan. 10	-	21.2	30.9	17.8	19.9
2019	Nov. 14 - Jan. 17	-	26.8	14.9	6.3	16.0

Table 2. Chemical composition (% DM) of grass hay or grass hay supplemented with a liquid, alfalfa hay or corn DDGS.

	HAY[1]	H-LQS	H-ALF	H-DDG
CP	7.9 ± 0.51	9.0 ± 0.44	10.9 ± 0.82	11.4 ± 0.56
ME, Mcal/lb	3.84 ± 0.64	4.17± 2.29	4.01 ± 0.66	4.32 ± 0.59
NDF	66.1 ± 0.69	65.4 ± 0.81	62.4 ± 1.59	60.7 ± 0.43
ADF	47.3 ± 0.96	47.8 ± 3.09	45.1 ± 1.47	42.5 ± 1.16
Ca	0.61 ± 0.04	0.54 ± 0.05	0.89 ± 0.03	0.53 ± 0.04
P	0.11 ± 0.04	0.16 ± 0.02	0.13 ± 0.04	0.24 ± 0.04

[1]HAY = grass hay, H-LQS = liquid-treated grass hay, H-ALF = grass hay plus alfalfa hay, H-DDG = grass hay plus corn DDGS.

Table 3. Cow performance data following bale grazing of grass hay, or grass hay supplemented with a liquid, alfalfa hay or corn DDGS.

	DMI lb/d	Initial BW lb	Final BW lb	ADG lb/d	Initial BCS	Final BCS	BCS change
Treatment							
HAY[1]	26.5[b]	1354	1337	-0.25[c]	5.8	5.7[b]	-0.08[b]
H-LQS	26.8[b]	1356	1363	0.12[b]	5.8	5.8[ab]	0.04[a]
H-ALF	26.7[b]	1363	1370	0.13[b]	5.8	5.8[ab]	0.03[ab]
H-DDG	30.1[a]	1349	1392	0.66[a]	5.8	5.9[a]	0.07[a]
SE	0.31	20.7	21.8	0.05	0.05	0.04	0.04
Year							
2016	26.6[c]	1302[c]	1256[b]	-0.64[c]	5.5[c]	5.4[c]	-0.13[c]
2017	27.5[ab]	1362[ab]	1423[a]	0.95[a]	5.4[d]	5.6[b]	0.22[b]
2018	28.0[a]	1400[a]	1412[a]	0.16[b]	6.5[a]	6.9[a]	0.39[a]
2019	27.3[b]	1357[b]	1368[a]	0.18[b]	5.8[b]	5.3[c]	-0.42[c]
SE	0.25	16.5	18.4	0.05	0.05	0.04	0.04
P-value							
Treatment	<0.001	0.92	0.09	<0.001	0.97	0.005	0.004
Year	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Treatment × Year	0.82	0.96	0.87	0.03	0.69	0.75	0.13

[1]HAY = grass hay, H-LQS = liquid-treated grass hay, H-ALF = grass hay plus alfalfa hay, H-DDG = grass hay plus corn DDGS.
[a-c]Means with a different letter within column for treatment or year differ ($P \leq 0.05$).

Results and Discussion

Cows offered only grass hay lost weight (Figure 1a) and condition (Figure 1b) in moderate and severe environmental conditions encountered during the study. Based on the 2016 NASEM model, grass hay provided adequate MP to meet protein requirements of nonlactating beef cows in the second trimester of pregnancy. Positive MP balance across four years of the study (Figure 2a) suggests that there was no apparent need for protein supplementation. Grass hay, however, did not provide adequate ME to meet daily cow ME requirements across all study years (Figure 2b), suggesting a need for supplementing cattle even in mild weather conditions as occurred in 2017.

Liquid supplementation increased dietary crude protein (CP) concentration above feeding grass hay only. Cows offered liquid-supplemented grass hay gained body weight except in severe environmental conditions (Figure 1a). These cows, however, lost condition except when mild environmental conditions were mild (Figure 1b). Liquid supplementation supplied MP in excess of cow requirements in all conditions encountered (Figure 2a). Liquid supplementation exceeded ME requirements in 2017, which was a mild year but did not supply adequate energy in a moderate year (2019) or in 2016 when severe environmental conditions occurred (Figure 2b). Liquid supplementation may be an option for cattle consuming low-quality grass hay in mild winters but cannot be the sole supplement as winters become severe.

Cows offered grass hay supplemented with alfalfa hay gained body weight (Figure 1a) and condition (Figure 1b) in mild weather but lost weight and condition in severe environmental conditions. Supplementing with alfalfa hay

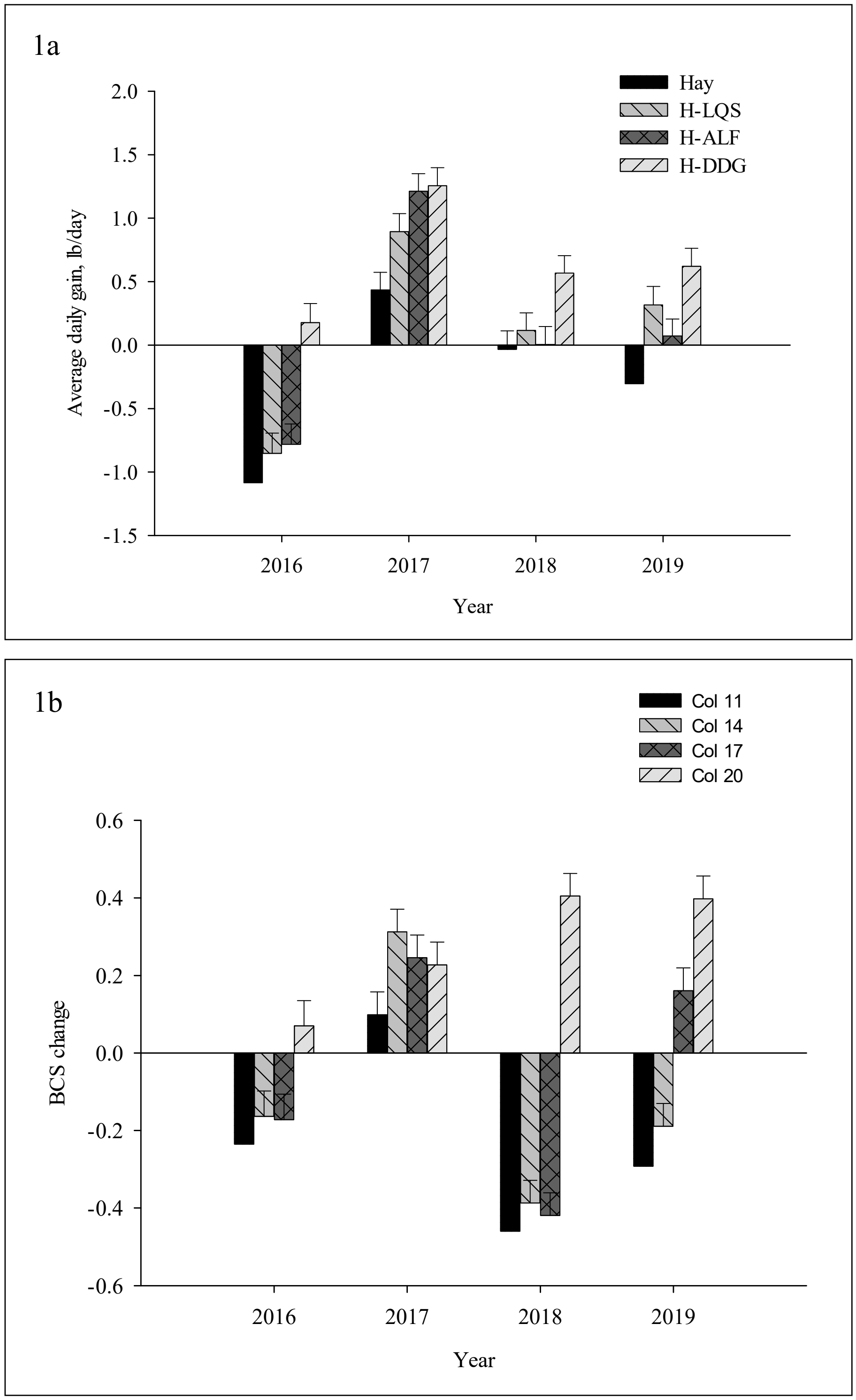

Figure 1: Average daily gains (1a) and BCS change (1b) in cows bale grazing grass hay or grass hay supplemented with a liquid, alfalfa hay, or corn DDGS.

supplied MP in excess of cow requirements in all environmental conditions encountered (Figure 2a). Supplementing with alfalfa hay did not provide adequate ME to meet cow ME requirements in cold winters, such as occurred in 2016 (Figure 2b). The 2016 NASEM model showed that alfalfa hay supplied adequate energy only during mild years but not in years with moderate or severe environmental temperatures (Figure 2b). In mild environmental temperatures such as those in 2017, alfalfa hay supplementation was nearly as effective as liquid supplementation in providing ME to meet cow energy requirements. Although alfalfa hay can effectively meet CP requirements in rations with low-quality roughages, alfalfa hay does not have the caloric density of oilseed meals or other by-product feeds to meet energy needs (DelCurto et al., 2000). In fact, the energy density of alfalfa is similar to that of high-quality grass hay. Weder et al (1999) reported improved animal performance when cattle grazing low-quality forage were offered higher-quality alfalfa hay.

Corn DDGS supplementation resulted in positive ADG (Figure 1a) and body condition (Figure 1b) across all environmental conditions encountered. Supplementing with corn DDGS resulted in the highest increase in dietary CP and supplied the highest amount of MP to cows across the years (Figure 2a). Feeding 4 lbs corn DDGS/head/day to cows bale grazing grass hay supplied ME in excess of cow requirements at all environmental temperatures encountered in this study (Figure 2b). Supplementing with DDGS supplied ME that exceeded requirements even in years with severe environmental temperatures such as those in 2016. As a supplement, corn DDGS compares favorably with other supplements such as soybean meal and canola meal since corn DDGS

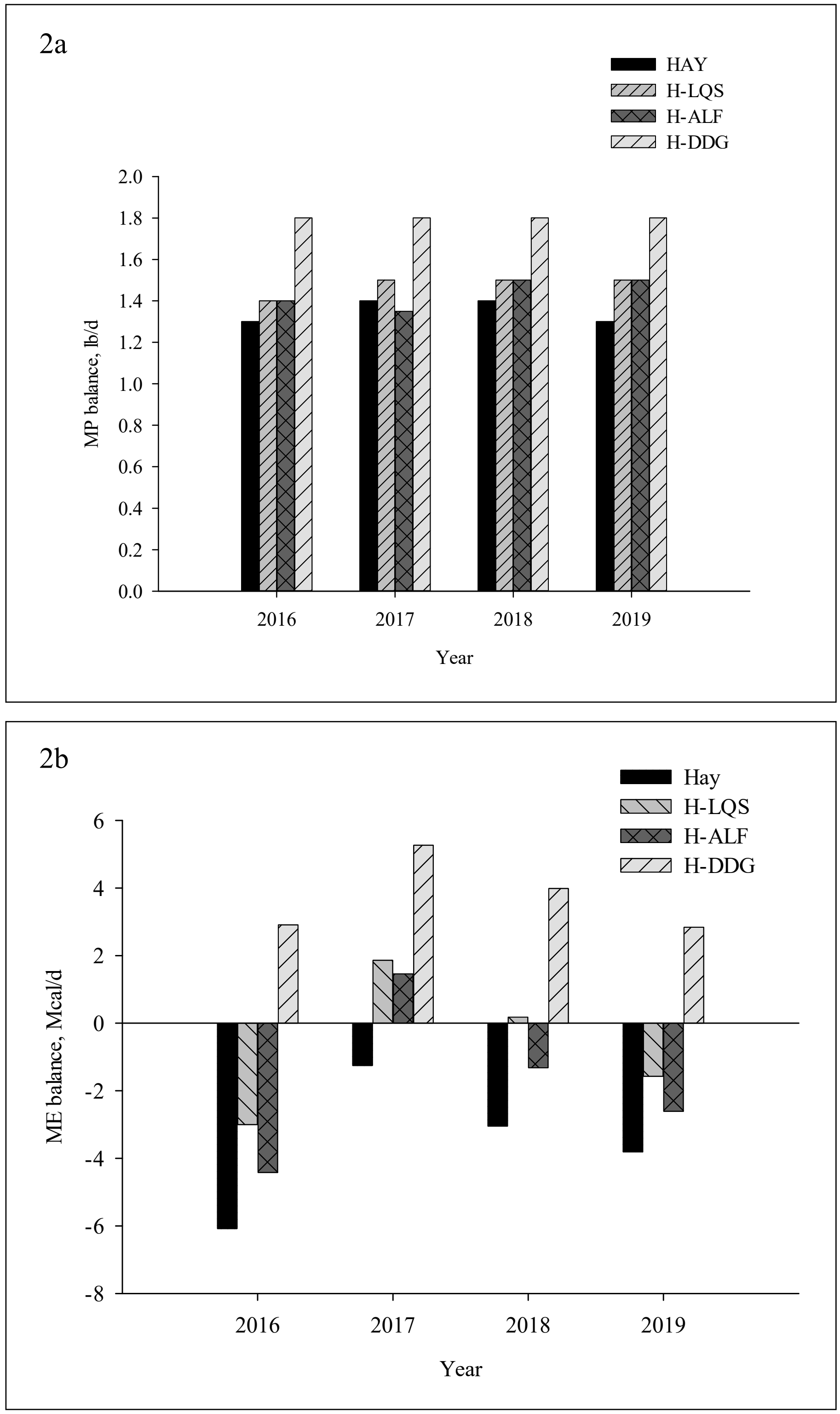

Figure 2. Predicted MP balance (2a), ME balance (2b) in cows bale grazing grass hay or grass hay supplemented with a liquid, alfalfa hay, or corn DDGS.

is a good source of protein, fat, phosphorus and readily digestible fiber (Klopfenstein et al., 2008). The low starch content of corn DDGS makes it a suitable supplement for grazing cattle (Klopfenstein et al., 2008). Among the supplements evaluated, corn DDGS is the only supplement that supplied adequate energy for pregnant beef cows that were bale grazing in all environmental conditions encountered in this study.

Supplementation costs ranged from $1.33 to $1.90/head/day for the different strategies. Predictably, bale grazing grass hay alone resulted in the lowest system costs. Minimizing use of purchased hay, reducing transportation costs and grazing hay bales in the fields from which the hay was baled would keep costs of bale grazing low. Liquid supplementation increased grazing costs by $0.26/head/day over grass hay due to the cost of the liquid supplement. Supplementing with alfalfa hay increased costs by $0.25/head/day over grass hay. The highest cost ($1.90/head/day) occurred when corn DDGS was offered as a supplement, mainly due to the cost of corn DDGS as well as labor required for twice-weekly visits to deliver it to cattle on pasture. Limiting delivery frequency to one visit per week would reduce the cost of corn DDGS supplementation.

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