Effects of starch- versus fiber-based supplements during winter grazing on growth rate of stocker cattle and final carcass characteristics

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STORY IN BRIEF

Fifty-three Angus steers (592 lb ± 49) grazed dormant tallgrass native range for 122 d and were supplemented with 1) 2.25 lb·animal^{-1}·d^{-1} of a cottonseed meal-based pellet supplement (**CON**); 2) CON plus corn-based supplement at 1% BW (**CORN**); 3) CON plus soybean hull-based supplement at 1% BW (**SBH**); or 4) distillers dried grains with solubles-based supplement at 1% BW (**DDGS**). All supplements were formulated to meet DIP requirements. Following the stocker phase, three randomly selected steers were harvested (intermediate harvest) from each treatment for measurement of carcass characteristics. Remaining steers grazed cool-season perennial grass pasture for 74 d prior to entering the feedlot for finishing. Steers were fed a dry-rolled corn finishing diet for 113 d before harvest. Average daily gain by steers on dormant native range was 0.45^{a}, 1.19^{c}, 0.76^{b}, and 0.78^{b} lb/d for treatments 1 through 4, respectively. Average daily gain was greater ($P < 0.001$) for supplemented steers compared with control steers and for steers supplemented with corn compared ($P < 0.001$) with the two high-fiber supplements (SBH and DDGS). At intermediate harvest, marbling scores were 120, 137, 150, and 157 (SEM = 25.4) for treatments one through four, respectively, (100 = practically devoid and 200 = traces) and were not different ($P = 0.75$) among treatments. There were no differences in growth rate during the finishing phase or final carcass characteristics. Marbling scores were 385, 373, 406, and 399 (SEM = 19.7; $P = 0.64$) for treatments 1 through 4, respectively (300 = slight and 400 = small). These data indicate that supplementation strategies that differ in type and amount of supplement may not influence marbling development by stocker cattle wintered on dormant native range. Even though energy supplementation increased ADG during the fall/winter grazing period, total energy intake in this production program was probably inadequate to influence fat accretion.

Key Words: stocker cattle, supplementation, winter grazing

INTRODUCTION

Over the last 20 yr the percentage of carcasses grading Prime or Choice has declined by 21.5% (Smith et al., 2006). Each production sector (seedstock generation, cow/calf production, stocking/backgrounding, and the feedlot finishing sector) ranked “Insufficient Marbling & Low Quality Grades” as the number one quality challenge facing the beef industry (Smith et al., 2006). Studies of nutrition and management practices that influence carcass traits like marbling deposition have primarily focused on the feedlot phase of production (Owens and Gardner, 2000). Intramuscular fat is considered the last fat depot to mature in beef cattle (McPhee et al., 2008); however, calves that were early weaned and sent directly to the feedlot showed increased marbling deposition at harvest compared with calves that were creep fed and normal weaned (Myers et al., 1999; Shike et al., 2007). Moreover, Faulkner et al. (1994) reported that creep feeding calves with corn for 113 d increased marbling scores at harvest when compared with

calves creep fed soyhulls. Acetate is a precursor to fatty acid synthesis in subcutaneous tissue, whereas intramuscular adipocytes preferentially use glucose carbons (Smith and Crouse, 1984). Every year there is a large number of fall-weaned calves that are wintered on dormant, low quality forages or crop residues that result in a high acetate:propionate fermentation in the rumen. Providing energy supplements to calves grazing dormant low quality forages increases growth rate and may increase glucose supply to increase marbling deposition. Therefore, the objective of this experiment was to examine the effects of high-starch vs. high-fiber based energy supplements on development of marbling by stocker cattle wintered on dormant tallgrass native range.

MATERIALS AND METHODS

Pasture Description. Angus steers grazed 320 acres of dormant native tallgrass prairie that was not grazed during the previous growing season at the Bluestem Stocker Range southwest of Stillwater, OK. The native tallgrass pastures contained mostly big bluestem (*Andropogon gerardii* Vitman), little bluestem (*Schizachyrium scoparium* [Michx.] Nash), and indiangrass (*Sorghastrum nutans* [L.] Nash).

Fall/Winter Grazing. Fifty-three Angus steers (592 lb ± 49) averaging 266 ± 4 d of age at the initiation of the trial were utilized for this experiment. Steers originated from a OSU cow herd and were weaned on October 10, 2007. Steers were stratified by initial body weight and randomly allotted to 1 of 4 treatments: 1) 2.25 lb·animal^{-1}·d^{-1} of a cottonseed meal-based pellet (**CON**; 1.29 Mcal of ME/lb DM, 43% CP); 2) CON plus corn-based supplement at 1% BW (**CORN**; 1.44 Mcal of ME/lb DM, 24% CP); 3) CON plus soybean hull-based supplement at 1% BW (**SBH**; 1.27 Mcal of ME/lb DM, 23% CP); or 4) distillers dried grains with solubles-based supplement at 1% BW (**DDGS**; 1.42 Mcal of ME/lb DM, 29% CP). All supplements were formulated to meet DIP requirements. Steers grazed dormant tallgrass native range for 122 d beginning on December 4, 2007 and were individually supplemented 5 d/wk. Twelve-hour shrunk body weights were measured on d 0, 30, 63, 93, and 122. Supplement consumption was adjusted after each weigh day to maintain desired intake levels. Backfat, ribeye area, and intramuscular fat deposition were measured by ultrasonography on d 107. At the conclusion of the grazing phase, three steers per treatment were randomly selected for intermediate harvest at the Food and Agricultural Processing Research and Technology Center at Oklahoma State University. Hot carcass weight, backfat, KPH, ribeye area, yield grade, and marbling scores were collected at harvest. The remaining steers were allowed to graze perennial cool season grass pasture for 74 d prior to placement into the feedyard. This was done because of the very high cost of gain in the feedyard at the time and the timing relative to availability of pen space.

Feedlot Phase. Thirty-nine steers (838 lb ± 61) were randomly allotted by body weight within treatment to one of three pens per treatment containing two to four steers per pen. Steers were fed a 45% concentrate starter ration and gradually stepped up to a dry rolled corn-based finishing diet (Table 1). The steers were fed ad-libitum twice daily for 113 d before being harvested at a commercial abattoir. Full body weights were measured on d 0, 28, 56, 85, and 113 to monitor weight gain during the finishing phase. Final carcass data were not collected on two red steers because the commercial abattoir would accept only black-hided cattle.

Table 1. Composition of diets fed to steers during the feedlot phase (%DM)

Item	Starter Ration	Step-up 1	Step-up 2	Finishing Ration
Alfalfa hay	17.50	5.00	2.50	-
Prairie Hay	17.50	20.00	12.50	6.00
Dry Rolled Corn	45.00	54.00	64.00	73.00
Wet Distillers Grain + Solubles	15.00	15.00	15.00	15.00
Supplement[a]	5.00	6.00	6.00	6.00

[a] Supplement consisted of: corn = 51.03%, limestone = 25.02%, urea = 9.04%, molasses = 4.11%, salt = 3.47%, KCl = 3.45%, MgO = 1.09%, $ZnSO_4$ = 2.02%, $CuSO_4$ = 0.09%, MnO = 0.07%, vitamin A = 0.06%, vitamin E = 0.04%, monensin (Rumensin; Elanco Animal Health, Greenfield, IN) = 0.32%, and tylosin (Tylan; Elanco Animal Health) = 0.19%.

Data were analyzed using the Mixed procedure of SAS (2003). The model included the fixed effect of treatment and LS-Means are reported. Orthogonal contrasts were used to test differences among preplanned treatment comparisons. Contrast one was a comparison between CON and the three energy supplement treatments. Contrast two was a comparison between the CORN supplement (high starch) and the two high fiber-based supplements (SBH and DDGS). Contrast three was a comparison between the two fiber-based supplements (SBH vs. DDGS).

RESULTS AND DISCUSSION

Fall/Winter Grazing. Average daily gain by steers was increased ($P < 0.001$) by supplementation (Table 2). The CORN steers had greater ADG ($P < 0.001$) than steers fed the SBH and DDGS-based supplements. Steers supplemented with either corn or corn gluten feed had greater ADG as compared with control steers, but ADG was similar between the corn and corn gluten supplemented steers (Elizalde et al., 1998). Merrill and Klopfenstein (1984) also found that ADG of steers grazing fall bromegrass pastures or heifers grazing cornstalk stubble was increased by supplementation with either rolled corn or soyhulls. However, there was no difference between type of supplements for ADG. Supplementation increased ultrasound ribeye area (REA) ($P < 0.01$) as compared with CON steers (Table 3). Aiken et al. (2005) also found that supplementation of ground corn to steers grazing bermudagrass for 112 d increased REA compared with non-supplemented steers when using ultrasonography.

There were few differences in intermediate carcass characteristics. The REA was larger ($P < 0.03$) for supplemented steers compared with CON steers (Table 3). The SBH steers had a larger REA and a lower yield grade than steers supplemented with DDGS. Marbling scores were not influenced by supplementation ($P = 0.37$).

Table 2. Effects of type and amount of supplement on grazing performance characteristics

	Treatment[a]					Contrast, *P*-value[b]		
Item:	CON	CORN	SBH	DDGS	SEM	C1	C2	C3
Steers, No.	14	13	13	13	-	-	-	-
Supp. Intake, lb/animal/d	2.25	5.88	5.95	5.27	-	-	-	-
BW, lb								
d 0	586	567	609	605	13.03	0.61	0.02	0.82
d 122	641	711	701	700	14.92	0.001	0.55	0.94
ADG, lb/d	0.45	1.19	0.76	0.78	0.09	0.001	0.001	0.88

[a] CON = cottonseed meal supplement; CORN = corn supplement; SBH = soybean hull supplement; DDGS = dried distillers grains plus solubles supplement
[b] C1 = CON vs. supplement treatments; C2 = CORN vs. SBH and DDGS; C3 = SBH vs. DDGS

Table 3. Effects of type and amount of supplement on ultrasound measurements and intermediate carcass characteristics collected at the end of the grazing phase

	Treatment[b]					Contrast, *P*-value[c]		
Item[a]	CON	CORN	SBH	DDGS	SEM	C1	C2	C3
Ultrasound Measurements								
Steers, No.	14	13	13	13	-	-	-	-
REA[d], in^2	6.41	7.17	7.49	7.25	0.21	0.001	0.45	0.42
IMF, %	3.02	2.85	2.71	2.92	0.11	0.14	0.77	0.18
FT, in	0.06	0.06	0.06	0.06	0.003	0.86	0.52	0.77
Intermediate Carcass Characteristics								
Steers, No.	3	3	3	3	-	-	-	-
HCW, lb	322	336	370	370	19.73	0.14	0.20	0.99
DP, %	50.07	50.49	51.77	52.83	1.81	0.46	0.44	0.69
FT, in	0.02	0.05	0.06	0.05	0.02	0.13	0.64	0.79
REA, in^2	7.03	8.17	8.63	7.37	0.35	0.03	0.70	0.03
Yield Grade	1.62	1.38	1.39	1.78	0.10	0.41	0.14	0.03
Marbling Score[e]	120	137	150	157	25.44	0.37	0.61	0.86

[a] REA = ribeye area; IMF = intramuscular fat; FT = fat thickness; DP = dressing percentage
[b] CON = cottonseed meal supplement; CORN = corn supplement; SBH = soybean hull supplement; DDGS = dried distillers grains plus solubles supplement
[c] C1 = CON vs. supplement treatments; C2 = CORN vs. SBH and DDGS; C3 = SBH vs. DDGS
[d] Body weight was used as a covariate when analyzing ultrasound REA
[e] Marbling score: 100 = Practically Devoid; 200 = Traces

Feedlot Phase. Supplemented steers were heavier ($P < 0.01$) entering the feedlot and maintained the weight advantage through the feedlot period as compared with the CON steers. There were no other treatment effects on feedlot performance (Table 4). Supplemented steers had greater yield grades ($P < 0.05$) as compared with the CON steers; however, there were no other

differences for final carcass characteristics (Table 5). Final marbling scores were 385, 373, 406, and 399 for treatments 1 through 4, respectively.

Table 4. Effects of type and amount of supplement while grazing dormant native range on subsequent feedlot performance

	Treatment[a]					Contrast, *P*-value[b]		
Item	CON	CORN	SBH	DDGS	SEM	C1	C2	C3
Steers, No.	11	8	10	10	-	-	-	-
BW, lb								
d 0	798	849	840	863	18.53	0.01	0.91	0.38
d 113	1236	1310	1289	1290	28.34	0.06	0.57	0.99
DMI, lb/hd/d	23.68	24.97	23.10	24.06	0.65	0.64	0.12	0.33
ADG, lb/d	3.87	4.08	3.97	3.77	0.17	0.72	0.35	0.40
Gain:Feed	0.16	0.16	0.17	0.16	0.005	0.85	0.89	0.06

[a] CON = cottonseed meal supplement; CORN = corn supplement; SBH = soybean hull supplement; DDGS = dried distillers grains plus solubles supplement
[b] C1 = CON vs. supplement treatments; C2 = CORN vs. SBH and DDGS; C3 = SBH vs. DDGS

Table 5. Effects of type and amount of supplement on final carcass characteristics

	Treatment[b]					Contrast, *P*-value[c]		
Item[a]	CON	CORN	SBH	DDGS	SEM	C1	C2	C3
Steers, No.	8	8	10	10	-	-	-	-
HCW, lb	753	795	781	787	18.95	0.14	0.66	0.80
DP, %	60.97	60.61	60.61	61.07	0.43	0.69	0.67	0.44
FT, in	0.52	0.55	0.56	0.60	0.05	0.31	0.57	0.47
KPH, %	1.63	2.31	2.25	2.10	0.20	0.02	0.59	0.58
REA, in^2	13.58	13.70	13.38	13.12	0.36	0.68	0.31	0.58
Yield Grade	2.63	2.97	3.04	3.23	0.19	0.05	0.49	0.45
Marbling Score[d]	385	373	406	399	19.73	0.75	0.23	0.79

[a] DP = dressing percentage; FT = fat thickness; REA = ribeye area
[b] CON = cottonseed meal supplement; CORN = corn supplement; SBH = soybean hull supplement; DDGS = dried distillers grains plus solubles supplement
[c] C1 = CON vs. supplement treatments; C2 = CORN vs. SBH and DDGS; C3 = SBH vs. DDGS
[d] Marbling score: 300 = Slight; 400 = Small

Previous studies have also indicated that supplementing corn or sorghum grain to steers grazing cool-season grass or perennial tallgrass prairie does not influence final marbling scores (Lake et al., 1974; Owensby et al., 1995). However, Lomas et al. (2009) found that steers supplemented with sorghum grain at 3.61 lb/d while grazing smooth bromegrass had increased final marbling scores. In this study, the amount and/or type of supplement did not affect the amount of intramuscular fat deposited in steers wintered on dormant native grass, even though energy supplementation increased ADG during the fall/winter grazing period. Growing cattle require a certain level of energy intake to meet requirements to deposit muscle and intramuscular fat

simultaneously (Bruns et al., 2005). In this production program the total energy intake was probably inadequate to influence intramuscular fat deposition and providing an energy supplement at the amount required to influence marbling deposition may not be economical.

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