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KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

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Abstract

A 70-day growing study was conducted to determine the effects of feeding a high-roughage diet for *ad libitum* intake or a high-energy limit-fed diet at equal energy intakes on growth performance of newly received growing beef cattle. A total of 392 crossbred heifers [initial body weight (BW) = 605 ± 58 lb] were blocked by weight (4), stratified by individual arrival weight within block, and allocated to 1 of 8 pens. Pens were randomly assigned to 1 of 4 dietary treatments to provide 8 replications per treatment for a total of 32 pens. Experimental diets included a high-roughage diet fed for *ad libitum* intake (AL) or a limit-fed high-energy diet fed at 75% (LIM-80), or 85% (LIM-85) of *ad libitum* intake. Treatments were designed to equalize for energy intake between calves assigned to AL and LIM-75. At the conclusion of the 70-day feeding period, final body weights and average daily gains did not differ ($P \geq 0.37$) between AL and LIM-75. Dry matter intake was greater ($P > 0.01$) for calves fed for *ad libitum* intake compared with limit-fed calves. As a result, feed-to-gain was lesser for LIM-75, LIM-80, and LIM-85 compared with AL. Overall, limit-feeding a high-energy diet to newly received beef cattle improved feed efficiency compared with feeding a traditional high-roughage diet for *ad libitum* intake.

Introduction

Newly received growing beef cattle face numerous stressors such as marketing, commingling, transportation, and pathogen exposure. On arrival, feed intakes are often low, and calves fed traditional high roughage growing diets may not consume enough dry matter to meet energy and protein requirements. One strategy to circumvent low dry matter intakes is to limit feed a more energetically dense diet. Previous research conducted at the Kansas State Beef Stocker Unit demonstrated improvements in feed efficiency when cattle were limit-fed a high-energy diet based on corn and co-products compared with a traditional high-roughage growing diet fed for *ad libitum* intake (Spore et al., 2019). In that study, energy intake was not balanced across diets; therefore, the objective of this experiment was to determine if providing equal amounts of energy from a high-roughage diet fed for *ad libitum* intake or a high-energy limit-fed diet influenced growth performance of growing beef cattle.

Experimental Procedures

A total of 392 crossbred heifers [initial body weight (BW) = 605 ± 58 lb] were purchased from a single source in Deming, NM, and transported to the Kansas State University Beef Stocker Unit on May 26, 2023. Heifers were randomly assigned to pens containing 12 to 13 head and offered a 60 Mcal net energy for gain (NE_g) diet at 1% of BW [dry matter (DM) basis] until the following day. Upon arrival, calves were individually weighed using a hydraulic squeeze chute, assigned a visual identification tag, drenched with 10% albendazole (Valbazen; Zoetis, Kalamazoo, MI), and pour-on diflubenzuron (Clean Up 2; Elanco Animal Health, Greenfield, IN). Prior to arrival, heifers completed a Vac-45 vaccination protocol, so no additional vaccinations were administered.

Cattle were blocked into four weight groups (light, medium-light, medium-heavy, or heavy), stratified by individual arrival weight within block, and assigned to pens containing 12 to 13 head. Within block, pens were randomly assigned to one of four experimental diets: a high-roughage diet formulated to provide 45 Mcal NE_g per 100 lb of DM and fed for *ad libitum* intake (AL) or a high-energy diet formulated to provide 60 Mcal of NE_g per 100 lb of DM and fed at 75% (LIM-75), 80% (LIM-80), or 85% (LIM-85) of *ad libitum* intake. Each treatment was replicated eight times for a total of 32 pens. On day 0, cattle were individually reweighed to determine initial BW, assigned a pen tag, and sorted by pen.

Experimental diets are presented in Table 1. Diets were formulated to provide 45 or 60 Mcal NE_g per 100 lb of DM. All diets contained 40% wet corn gluten feed (DM basis; Sweet Bran; Cargill Animal Nutrition). To ensure monensin intake was similar across treatments, dry-rolled corn replaced proportions of supplement in limit-fed diets as feed offered was increased. Heifers were fed once daily at 7:00 a.m. using a Roto-Mix feed wagon (Model #414-14B; Roto-Mix, Dodge City, KS). Cattle fed for *ad libitum* intake were initially fed at 2.2% BW (DM basis). Feed refusals for cattle fed for *ad libitum* intake were weighed daily, and feed calls were adjusted so that 10% of DM fed the previous day remained at 6:30 a.m. Within block, feed intake of the two pens fed for *ad libitum* intake was averaged. Feed offered to limit-fed calves was then calculated within each weight block by multiplying average *ad libitum* intake by 75, 80, or 85%. As a result, energy intake was equal between heifers fed AL compared with heifers fed LIM-75. At the completion of the 70-day feeding period, calves were individually weighed.

Results and Discussion

Following the 70-day feeding period, final BW and average daily gains (ADG) did not differ ($P \geq 0.37$; Table 2) between AL and LIM-75. Among limit-fed calves, final BW and ADG were greater ($P < 0.01$) in LIM-85 compared with LIM-75, whereas final BW and ADG in LIM-80 was intermediate to and not different ($P \geq 0.37$) from LIM-75 or LIM-85. By design, DM intake was lower ($P < 0.01$) for LIM-75, LIM-80, and LIM-85 compared with AL. As a result, feed-to-gain was greater ($P \leq 0.02$) for calves fed for *ad libitum* intake compared with limit-fed calves; however, feed-to-gain did not differ ($P \geq 0.83$) among limit-fed calves. Similar weight gains between AL and LIM-75 suggest that restricting feed intake while maintaining energy intake does not negatively influence growth performance of newly received growing beef cattle.

Implications

The data presented suggest that higher energy rations limit-fed to cattle during the receiving period positively impact feed to gain conversion when compared to lower energy rations fed at the same net energy intake. From these conclusions, it can be predicted that producers can use this feeding technique to program gains based on forage cost and feeding period length to maximize feed utilization and minimize feed cost in their cattle.

References

Spore, T. J., Montgomery, S. P., Titgemeyer, E. C., Hanzlicek, G. A., Vahl, C. I., Nagaraja, T. G., Cavalli, K. T., Hollenbeck, W. R., Wahl, R. A., and Blasi, D. A. 2019. Effects of high-energy programmed feeding protocol on nutrient digestibility, health, and performance of newly received growing beef cattle. Applied Animal Science 35:397–407. doi:10.15232/aas.2019-01853

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Table 1. Experimental diets

	Diet[1]			
Ingredient, % of dry matter	**AL**	**LIM-75**	**LIM-80**	**LIM-85**
Dry-rolled corn	14.38	40.50	40.97	41.38
Supplement[2]	5.63	7.50	7.03	6.62
Prairie hay	40.00	12.00	12.00	12.00
Sweet Bran[3]	40.00	40.00	40.00	40.00

[1] AL = High-roughage diet formulated to provide 45 Mcal net energy for gain (NE_g) per 100 lb of dry matter (DM) and fed for *ad libitum* intake; High-energy diet formulated to provide 60 Mcal of NEg per 100 lb of DM and fed at 75% (LIM-75), 80% (LIM-80), or 85% (LIM-85) of *ad libitum* intake.

[2] Pelleted supplement formulated to include (DM); 11.5% crude protein, 0.60% phosphorus, 4.7% salt, 0.80% potassium, 2.5% fat, and 307.2 g/ton monensin (Rumensin; Elanco, Greenfield, IN).

[3] Cargill Animal Nutrition (Blair, NE).

Table 2. Effects of dietary energy concentration and feed intake on growth performance of growing beef cattle

	Treatment[1]					
Item	**AL**	**LIM-75**	**LIM-80**	**LIM-85**	**SEM[1]**	***P*-value**
Number of pens	8	8	8	8		
Number of animals	98	98	98	98		
Body weight, lb						
Day 0	605	604	605	605	0.2	0.34
Day 70	805[a]	813[ab]	828[bc]	841[c]	6.4	< 0.01
Average daily gain, lb/day	2.86[a]	2.98[ab]	3.18[bc]	3.37[c]	0.090	< 0.01
Dry matter intake, lb/day	23.46[a]	17.37[b]	18.68[bc]	19.04[c]	0.557	< 0.01
Gain:Feed, lb/lb	0.12[a]	0.16[b]	0.16[b]	0.17[b]	0.010	0.02
Feed:Gain, lb/lb	8.26[a]	6.24[b]	6.38[b]	6.22[b]	0.517	0.04

[1] AL = High-roughage diet formulated to provide 45 Mcal net energy for gain (NE_g) per 100 lb of dry matter (DM) and fed for *ad libitum* intake. High-energy diet formulated to provide 60 Mcal of NEg per 100 lb of DM and fed at 75% (LIM-75), 80% (LIM-80), or 85% (LIM-85) of *ad libitum* intake.

[2] Standard error of the mean.

[a-c] Within rows, means with unlike superscripts differ ($P \leq 0.05$).