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EFFECTS OF ENERGY RESTRICTION AND REALIMENTATION ON THE DEVELOPMENT OF CARCASS TRAITS OF YEARLING HEIFERS

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Summary

Feedlot performance and carcass development were compared between heifers fed a low energy diet for an 88-day backgrounding period before receiving a high energy diet (LE) and heifers receiving a high energy diet throughout the trial (HE). The LE heifers were delayed in carcass and muscle growth ($P<.10$) when compared to HE heifers on day 89. At an 1100 lb weight constant, LE and HE carcasses had similar dissected muscle weights, rib fat measurements and marbling scores. Carcass dressing percentage was only affected by time ($P<.10$) on an energy dense diet at 1030 lb. During the initial 88-day background period, HE heifers had higher ADG ($P<.001$) and lower feed/gain requirements ($P<.001$). During realimentation, compensatory growth was exhibited through increased ADG ($P<.10$) and improved feed/gain ($P<.05$) for LE heifers. From day 0 until slaughter, the cumulative ADG for HE heifers was greater ($P<.05$) and the cumulative feed conversion was lower for HE heifers ($P<.10$).

(Key Words: Backgrounding, Compensatory Growth, Feedlot, Carcass Traits, Yearling Heifers.)

Introduction

Backgrounding is a management practice frequently used by the cattle industry. During the subsequent period of realimentation, improved feed efficiency and ADG occur. This compensatory growth is apparent when compared to contemporaries of similar weight classes that have not been backgrounded. The improved performance can occur during the later period of growth when feed efficiency and gains are typically declining. The increased efficiency has, in part, been attributed to a deferment of body fat deposition until body weights are heavier.

This study was designed to characterize the effects of energy restriction and realimentation on feedlot performance and carcass characteristics compared to an ad libitum feeding finishing diet regimen. This research is part of a larger study that will characterize effects of energy restriction and realimentation on carcass composition and growth mechanisms of skeletal muscle.

Materials and Methods

The 58 Limousin x Angus heifers (608 lb) used in this study were selected from a group of 69 heifer calves. The calves were shipped to Brookings at the end of October on the day of weaning. They were vaccinated for IBR, BVD, PI_3, BRSV, 7-way clostridia and Haemophilus[4] within 24 hours of feedlot arrival. Ivermectin[5] was used for parasite control. The heifers were fed to maintain body weight (Table 1) for 37 days before being put on test in early December. Twenty-eight heifers were selected for uniformity of weight and type and allotted to pens of four in Block 1. The seven pens of heifers in Block 1 were designated to be serially slaughtered for comparisons of carcass and muscle characteristics. One of these pens was designated as an initial slaughter group for analyses

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TABLE 1. EXPERIMENTAL DIET COMPOSITIONS[a]

Ingredient	Diet		
	Low energy[bc]	High energy[b]	Maintenance[b]
Hay		10.00	50.00
Wheat straw	15.00		
Corn silage	74.94		
Ground corn cobs			1.00
Whole shelled corn		81.61	44.80
Soybean meal, 44%	9.21	4.60	1.80
Molasses		2.25	2.00
Trace mineralized salt	.30	.30	.30
Calcium carbonate	.55	1.01	
Dicalcium phosphate			.10
Potassium chloride		.23	
Nutrient Composition			
Crude protein, %	11.04	11.77	12.51
Calcium, %	.439	.505	.496
Phosphorus, %	.235	.290	.279
Potassium, %	1.146	.803	1.348
NE_m, Mcal/cwt	69.3	93.5	77.4
NE_g, Mcal/cwt	38.5	61.8	45.4

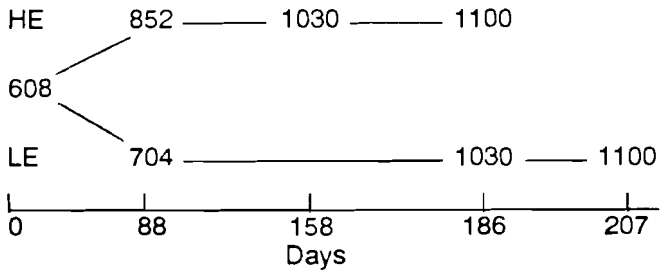
[a] Percentage of dry matter unless otherwise stated.
[b] Provides 30 g/T Lasalocid and 1000 IU/lb supplemental vitamin A.
[c] Provides 30 g/T Lasalocid days 1 to 36 and 25 g/T of monensin days 37 to 88.

not included in this report. An additional 30 heifers were allotted to pens of five in Block 2 for comparisons of feedlot performance. Three pens in each block were assigned to a low energy diet or a high energy diet. Feed delivery remained constant while individual weights were taken the first 2 days of the trial to determine initial weight. On day 89, two pens of heifers fed the low energy diet were stepped up to the high energy diet. Individual live body weighs were recorded every 28 days and 1 day before a scheduled slaughter. All heifers in Block 2 were continued on experiment until all pens from Block 1 were slaughtered. Feed deliveries were recorded daily and sampled weekly to determine DMI.

One pen from each diet treatment in Block 1 was slaughtered on day 89. The remaining two pens in Block 1 were slaughtered when pen average body weights approached 1030 or 1100 lb to allow age or weight constant slaughter points (Figure 1). The supraspinatus and the semitendinosus (eye of the round) muscles were dissected from the hot carcass. Hot carcass weights were recorded with the muscle dissection weights added back to the respective carcass weight. The muscle dissections were chilled for 24 hours, trimmed of fat and weighed. Rib eye area, rib fat and marbling score were determined after a 48-hour chill.

Carcass data from Block 1 were tested by procedures appropriate for a completely random design with the carcass representing the experimental unit. Data were analyzed on a weight constant (1030 vs 1100 lb) or a time constant (89 vs 186 days) basis.

Figure 1. AGE AND WEIGHT AT SLAUGHTER DATES



Analysis of variance was accomplished using the GLM procedure and CONTRAST option of SAS. Comparisons were made on a time or weight constant basis by orthogonal contrast.

Feedlot performance data from pens in Block 2 were analyzed by procedures appropriate for a completely random design with pen representing the experimental unit. Analysis of variance was accomplished using the GLM procedure of SAS.

Results and Discussion

Low energy heifers slaughtered on day 89 were lighter and produced lighter carcasses than HE heifers ($P<.001$, Table 2). The dissected muscle weight was lighter for the supraspinatus ($P<.05$) and semitendinosus ($P<.10$) muscles for the LE carcasses. Backgrounding the heifers did not limit muscle growth potential or promote it once realimentation occurred. When dissected muscle weights were compared at the 1100-lb weight constant, the supraspinatus and the semitendinosus muscle weights were similar between LE and HE treatments (Table 3). Compensatory growth was apparently completed prior to 1100 lb, since growth from 1030 to 1100 lb did not result in increased muscle weight. In fact, a decrease in muscle size was observed. This may have been due to heifers in the slaughter groups differing in muscularity independent of treatment effects. At weight constant end points, rib fat and marbling score were similar for LE and HE.

Rib fat and marbling score increased ($P<.001$) from day 89 to day 186. After the backgrounding period on day 89, the LE carcasses had lower marbling scores ($P<.05$). This also occurred at day 186 where LE heifers again produced less marbling ($P<.10$), although rib fat at this point was similar ($P>.10$). This is supported by other experiments which have shown that age and days on feed with an energy dense diet have a greater impact on marbling score than the amount of external fat. Carcass dressing percentage was affected only by diet at the 1030-lb weight constant comparison ($P<.10$).

The 30 heifers in Block 2 were used in the analysis of feedlot performance. The LE heifers exhibited compensatory growth by exhibiting higher ADG ($P<.10$) and lower feed/gain ($P<.05$) than HE heifers from day 89 to 207 (Table 4). On day 133, the LE heifers were similar in live weight to the HE heifers (976 vs 1037 lb, $P>.10$). The cumulative ADG from day 0 to slaughter was greater for HE heifers ($P<.05$). Feed conversion was lower ($P<.001$) for HE heifers during the initial 88 days. The cumulative feed conversion favored the HE diets ($P<.10$).

These data indicate that backgrounding heifers limited the amount of fat deposited and the amount of muscle growth during the backgrounding period. During realimentation, backgrounded heifers experienced a period of rapid growth and increased efficiency. This compensatory growth represented muscle growth and an increase in body fat. In this study, the effects of backgrounding on carcass traits had diminished by the time heifers weighed 1100 lb.

TABLE 2. CARCASS CHARACTERISTICS FOR TIME CONSTANT END POINTS (BLOCK 1)

	Day 88		Day 186		
Item	LE	HE	LE	HE	SEM
Live wt, lb[bdi]	704	852	1041	1099	23.00
Carcass wt, lb[bdi]	435	536	643	685	14.09
Dressing percent	61.9	62.9	61.8	62.4	.71
Rib eye area, in.[2gi]	10.7	11.8	12.9	11.4	.49
Rib eye area/cwt[def]	2.4	2.2	2.0	1.7	.08
Rib fat, in.[d]	.13	.15	.33	.43	.04
Marbling score[adei]	3.3	4.4	4.7	5.6	.28
Supraspinatus wt, lb[de]	1.90	2.15	2.38	2.36	.07
Semitendinosus wt, lb[h]	3.51	4.28	4.52	3.94	.29

[a] 4.0 = Slight^{0}, 5.0 = Small^{0}.
[b] LE 88 vs HE 88 (P<.001).
[c] LE 186 vs HE 186 (P<.001).
[d] Day 88 vs day 186 (P<.001).
[e] LE 88 vs HE 88 (P<.05).
[f] LE 186 vs HE 186 (P<.05).
[g] Day 88 vs day 186 (P<.10).
[h] LE 88 vs HE 88 (P<.10).
[i] LE 186 vs HE 186 (P<.10).

TABLE 3. CARCASS CHARACTERISTICS FOR WEIGHT CONSTANT END POINTS (BLOCK 1)

	Group 1030		Group 1100		
Item	LE	HE	LE	HE	SEM
Live wt, lb[b]	1041	1025	1120	1099	27.33
Carcass wt, lb[b]	643	655	703	685	16.88
Dressing percent[c]	61.8	63.9	62.8	62.4	.71
Rib eye area, in.[2b]	12.9	13.3	11.2	11.4	.59
Rib eye area/cwt[b]	2.00	2.04	1.59	1.66	.10
Rib fat, in.	.33	.45	.40	.43	.05
Marbling score[a]	4.7	5.6	5.6	5.6	.47
Supraspinatus wt, lb[c]	2.38	2.13	2.35	2.36	.09
Semitendinosus wt, lb	4.52	4.41	4.18	3.94	.26

[a] 4.0 = Slight^{0}, 5.0 = Small^{0}.
[b] 1030 vs 1100 (P<.05).
[c] LE 1030 vs HE 1030 (P<.10).

TABLE 4. PERFORMANCE OF LE AND HE HEIFERS (BLOCK 2)

Period	Item	LE	HE	SEM
	Initial wt	616	619	19.52
0 to 89 days	Live wt[cd]	773	868	24.47
	ADG[a]	1.76	2.79	.086
	DMI[b]	14.7	17.4	.665
	Feed/gain[a]	8.35	6.21	.171
90 to 207 days	Live wt[d]	1140	1187	20.00
	ADG[b]	3.12	2.70	.090
	DMI	21.7	20.8	.603
	Feed/gain[b]	6.97	7.70	.131
0 to 207 days	ADG[c]	2.53	2.74	.063
	DMI	18.5	19.3	.521
	Feed/gain[c]	7.33	7.05	.088

[a] $P<.01$.
[b] $P<.05$.
[c] $P<.10$.
[d] Taken on last day of period.