1987

Effect of Restricting Feed Intake During the Finishing Phase on Feedlot Performance and Dietary Energy Utilization

J.J. Wagner
South Dakota State University

EFFECT OF RESTRICTING FEED INTAKE DURING THE FINISHING PHASE ON FEEDLOT PERFORMANCE AND DIETARY ENERGY UTILIZATION

J. J. Wagner[1]
Department of Animal and Range Sciences

CATTLE 87-8

Summary

A total of 192 yearling Angus steers were used in two trials to investigate the impact of restricting feed intake on feed conversion and energy utilization. In trial 1, feed intake was restricted to approximately 83% of ad libitum. Cattle were slaughtered at a constant fatness. In trial 2, intake was restricted to approximately 93 and 85% of ad libitum. After 56 days on feed, half of the 85% cattle were allowed to consume feed ad libitum. Cattle were slaughtered at a constant cumulative NEg intake. Average daily gain was reduced for the restricted intake cattle compared with controls. Carcass fatness was not altered by restricting feed intake. Feed conversion and calculated dietary net energy values were not improved by restricting feed intake. Use of the net energy system appears valid over several levels of feed intake.

(Key Words: Restricted Intake, Limit Feeding, Finishing Programs.)

Introduction

Typically cattle are full-fed high energy diets during the finishing phase. Maximum energy intake generally promotes the greatest average daily gain by cattle. Some researchers have suggested that feed conversion could be improved by restricting the intake of finishing cattle. Such an improvement may be the result of improved energy utilization and(or) less feed waste. If energy utilization is altered at lower levels of feed intake, adjustments in net energy values would be necessary.

Previous trials evaluating restricted intake have ended on the same day, leaving total dietary energy intake has been confounded with treatment. Feeding cattle to a common total energy intake would allow conclusions to be drawn regarding the efficiency of energy utilization at various levels of daily intake. Cattle feeders feed cattle to a common endpoint (i.e., low choice grade). In the industry, cattle that are fed using a restricted intake regimen would be fed to the same endpoint as cattle fed a traditional finishing program. Data concerning the efficacy of restricted intake finishing of cattle to a common endpoint are needed by the industry.

The objectives of this research were to determine the effect of restricted intake during the finishing phase on cattle performance, energy utilization and carcass merit when cattle were fed to a common total energy intake or a common fatness.

Materials and Methods

A total of 192 yearling Angus steers were utilized in two trials. All cattle were part of a winter growing study and had been at the research center for over 90 days prior to the study. Cattle were implanted at the start of the trial with Ralgro[2]. In both trials, all cattle were fed varying amounts of a common high energy finishing diet (table 1).

In trial 1, 64 cattle were stratified by weight and allotted to eight concrete surfaced pens. Cattle in four pens were allowed to consume ad libitum amounts of dry matter. Cattle in the four remaining pens were fed approximately 85% of what the ad libitum fed cattle consumed. These cattle were slaughtered as five of eight head in each pen reached an anticipated low choice grade.

---

[1] Assistant Professor.
[2] International Minerals and Chemical Corporation, Terre Haute, Indiana.

TABLE 1. DIET COMPOSITION FED TO STEERS IN TRIALS 1 AND 2

Item	Percentage of dry matter
Whole shelled corn	52.80
Ground high moisture corn	25.00
Corn silage	15.00
Supplement	
Soybean meal	5.65
Limestone	1.00
Trace mineralized salt[a]	.30
Cane molasses	.20
Vitamin A-30[b]	.03
Rumensin 60[c]	.03
Nutrient[d]	
NEm[e]	92.05
NEg[e]	61.31
Crude protein	11.02
Potassium	.53
Calcium	.47
Phosphorus	.33

[a] Composition, minimum percentage, NaCl 96.0, Zn .350, Mn .209, Fe .200, Mg .150, Cu .003, I .007 and Co .005.
[b] Contains 30,000 IU vitamin A per gram.
[c] Contains 60 g monensin per pound.
[d] Calculated from NRC, 1984.
[e] Net energy for maintenance, mcal/cwt dry matter; net energy for gain, mcal/cwt dry matter.

In trial 2, 128 cattle were stratified by weight and allotted to 16 dirt surfaced pens. Four pens of cattle were allowed to consume ad libitum amounts of dry matter. Cattle in four pens were fed approximately 93% and eight pens of cattle were fed approximately 85% of what the ad libitum cattle consumed. After 56 days, four pens of the 85% cattle were fed ad libitum amounts of dry matter. Cattle on the ad libitum regimen for the entire trial were slaughtered as five of eight head in each pen reached an anticipated low choice grade. Restricted intake cattle were slaughtered as each pen achieved similar cumulative net energy for gain intakes as the ad libitum fed cattle.

Dietary energy values were computed using net energy relationships (Owens et al., 1984). Estimated energy values are based on average weight, average daily gain, days on feed and average daily dry matter intake.

Cattle were weighed initially on two consecutive mornings following an overnight withdrawal (16 hours) of feed and water. Prior to slaughter, cattle were weighed full and following an overnight withdrawal (14 hours) of feed and water. Shrink was calculated using these two weights. Dressing percent was calculated using hot carcass weight and shrunk weight prior to slaughter. Treatment differences for shrink and dressing percent were not significant. Therefore, final weights are the shrunk weights prior to slaughter and have not been adjusted to a common dressing percent. All interim weights were obtained following 14 hours withdrawal of feed only.

Data were analyzed as a completely randomized design on a pen mean basis. Carcass fat thickness measured between the 12th and 13th rib was used as a covariate in the analysis of trial 1 and total net energy available for gain intake was used as a covariate in the analysis of trial 2. Variables of interest were average daily gain, feed intake, feed conversion, carcass characteristics. Dietary energy values calculated from the performance data from each pen were also examined. Treatment means were separated using least significant difference procedures.

Results and Discussion

Performance of cattle in trial 1 is shown in table 2. Average daily dry matter intake for the full-fed group averaged 19.42 lb/head for the entire trial. Restricted intake cattle averaged 83.1% of the daily dry matter intake as the ad libitum cattle. Average daily gain for the ad libitum cattle tended to be greater than the restricted cattle (2.53 vs 2.04 lb/head/day for the entire trial). Days on feed tended to be greater for the restricted intake cattle than for the full-fed cattle (115 vs 106 days).

TABLE 2. PERFORMANCE OF CATTLE FED IN TRIAL 1[a]

Item[b]	Treatment		SEM[c]
	Ad libitum	Restricted	
Initial wt, lb	826	830	2.67
DMI 14, lb	17.80[e]	13.23[f]	.09
DMI 28, lb	18.74[e]	13.53[f]	.15
DMI 56, lb	19.33[e]	14.42[f]	.21
DMI T, lb	19.42[e]	16.13[f]	.34
ADG 14, lb	3.40	1.56	.81
ADG 28, lb	2.91[e]	1.60[f]	.03
ADG 56, lb	2.88[e]	2.25[f]	.10
ADG T, lb	2.53	2.04	.14
F/G 14[d]	5.24	8.48	--
F/G 28	6.61[e]	8.43[f]	.10
F/G 56	6.83	6.37	.18
F/G T	7.79	7.86	.46
Slaughter wt, lb	1090	1065	15.07
Days on feed	106	115	6.06

[a] Least-squares means adjusted to a common fat thickness.
[b] DMI, ADG and F/G = cumulative daily dry matter intake, average daily gain and feed/gain, respectively, and 14, 28, 56 and T = 14, 28, 56 days and total trial, respectively.
[c] Standard error of the mean.
[d] Least-squares mean for DMI 14/ADG 14.
[e,f] Means in each row with unlike superscripts differ ($P<.05$).

One pen of cattle on the restricted intake treatment lost .4 lb/head/day during the first 14 days of the trial. Consequently, least squares means for feed efficiency at 14 days were negative. Data in the table for feed conversion at 14 days were calculated from the least-squares means for average daily gain and dry matter intake.

Feed conversion was not improved by restricting intake. For the entire trial, feed conversion was 7.79 for the full-fed cattle vs 8.43 for the restricted intake cattle. These cattle were fed to a common fat thickness and slaughter grade.

Calculated dietary net energy concentrations were not altered by restricted feeding. Net energy for maintenance and gain for the full-fed cattle vs the restricted intake cattle were 89.74 and 59.15 vs 93.87 and 62.00 mcal/cwt dry matter, respectively (standard error 4.41 and 2.64 for NEm and NEg, respectively).

Carcasses of restricted intake cattle were significantly lighter and had smaller rib eye areas than full-fed cattle (660 vs 684 lb and 11.71 vs 12.17 sq in, respectively). All other carcass traits were similar for the full-fed cattle and the restricted intake cattle (table 3).

TABLE 3. CARCASS DATA, TRIAL 1[a]

Item	Treatment		SEM[b]
	Ad libitum	Restricted	
Dressing percent	62.83	61.99	1.00
Hot carcass weight, lb	684[e]	660[f]	1.90
Fat thickness, inches[c]	.56	.57	--
Marbling[d]	5.54	5.45	.16
Kidney, heart and pelvic fat, %	1.93	2.13	.19
Rib eye area, sq in	12.17[e]	11.71[f]	.05
Percent choice	83.48	79.47	12.28
Yield grade	3.01	3.10	.05

[a] Least-squares means adjusted to a common fat thickness.
[b] Standard error of the mean.
[c] Raw means.
[d] Small^{o} = 5.00; Modest^{o} = 6.00.
[e,f] Means in each row with unlike superscripts differ (P<.05).

Performance of steers in trial 2 is displayed in table 4. At 56 days, average daily dry matter intake was 19.31 lb per head for the ad libitum treatment. Average daily intake for the 93, 85 and 85+% treatments were 18.12 (93.8%), 17.46 (88.7%) and 16.88 (87.4%) lb/head. For the entire trial, average daily intake for the ad libitum, 93, 85 and 85+ treatments were 19.34 , 18.22 (94.2%), 17.46 (90.3%) and 17.95 (92.8%) lb/head.

TABLE 4. PERFORMANCE OF STEERS FED IN TRIAL 2[a]

Item[b]	Treatment				SEM[c]
	Ad libitum	93%	85%	85+%	
Initial wt, lb	828	824	827	827	1.22
DMI 14, lb	17.87[d]	17.31[e]	15.48[f]	15.60[f]	.15
DMI 28, lb	18.81[d]	17.76[e]	16.53[f]	16.47[f]	.13
DMI 56, lb	19.31[d]	18.12[e]	17.12[f]	16.88[f]	.14
DMI T, lb	19.34[d]	18.22[e]	17.46[f]	17.95[e]	.15
ADG 14, lb	4.47[d]	3.59[de]	3.31[e]	2.47[e]	.40
ADG 28, lb	3.17[d]	2.53[e]	2.40[e]	1.69[f]	.21
ADG 56, lb	3.34[d]	3.01[de]	2.93[e]	2.60[e]	.15
ADG T, lb	2.79[d]	2.47[de]	2.43[df]	2.39[e]	.11
F/G,14	3.95[d]	4.86[d]	4.88[d]	6.78[e]	.69
F/G 28	5.88[d]	7.25[d]	6.94[d]	10.07[e]	.92
F/G 56	5.81	6.08	5.85	6.49	.28
F/G T	7.00	7.39	7.21	7.53	.29
Slaughter wt, lb	1106[d]	1098[e]	1120[f]	1098[e]	11.67
Days on feed	100[d]	111[e]	120[f]	113[e]	1.64

[a] Least-squares means adjusted to a common total NEg intake.
[b] DMI, ADG and F/G = cumulative daily dry matter intake, average daily gain and feed/gain, respectively, and 14, 28, 56 and T = 14, 28, 56 days and total trial, respectively.
[c] Standard error of the mean.
[d,e,f] Means in each row with unlike superscripts differ (P<.05).

Average daily gain was greatest and days on feed were lowest for the ad libitum treatment. For the entire trial, full-fed cattle gained 2.79 lb/head/day compared with 2.47, 2.43 and 2.39 for the 93, 85 and 85+ groups, respectively. The ad libitum cattle required 100 days on feed to reach the low choice grade. The 93, 85 and 85+ cattle required 111, 120 and 113 days, respectively, to reach similar energy intakes as the full-fed cattle.

Feed conversion was not affected by limit feeding (table 4). Feed conversion for the entire trial was 7.00 vs 7.39, 7.21 and 7.53 for the ad libitum vs 93, 85 and 85+ cattle, respectively. Calculated net energy values were similar for all treatments (table 5), indicating that level of feed intake did not alter energy utilization.

TABLE 5. CALCULATED DIET ENERGY VALUES[a]

Item[b]	Treatment				SEM[c]
	Ad libitum	93%	85%	85+%	
NEm	97.58	93.97	98.54	93.50	2.93
NEg	63.53	62.13	64.54	61.83	1.69

[a] Calculated from net energy relationships (Owens et al., 1984).
[b] NEm = Net energy for maintenance, mcal per cwt dry matter; NEg = net energy for gain, mcal per cwt dry matter.
[c] Standard error of the mean.

Average feed intake by period for trial 2 is displayed in table 6. After 56 days on feed, the 85+ cattle were full fed. From 70 to 84 days, feed intake for the ad libitum and 85+ cattle were similar (19.20 and 19.24 lb/head/day, respectively). Dry matter intakes for the 85+ cattle tended to be greater than intakes for the ad libitum cattle (19.58 vs 18.80 lb/head/day) during days 84 to 98.

TABLE 6. AVERAGE FEED INTAKE BY PERIOD, TRIAL 2

Item	Treatment				SEM[a]
	Ad libitum	93%	85%	85+%	
0-28 days	18.83^{b}	17.77^{c}	16.53^{d}	16.45^{d}	.15
28-56 days	19.76^{b}	18.42^{c}	17.72^{cd}	17.38^{d}	.22
56-70 days	19.07^{b}	18.14^{c}	17.61^{c}	18.50^{bc}	.28
70-84 days	19.20^{bc}	18.46^{bc}	18.13^{c}	19.24^{b}	.26
84-98 days	18.80^{bc}	18.61^{c}	17.92^{c}	19.58^{b}	.30

[a] Standard error of the mean.
[b,c,d] Means in each row with unlike superscripts differ ($P<.05$).

Carcass data are displayed in table 7. There were no treatment differences for any of the carcass traits, indicating that feeding to constant cumulative NEg intake yielded similar carcass endpoints and presumably similar carcass energy gains.

Feed conversion and calculated dietary energy values were not improved by restricting feed intake. The net energy system appears valid over a wide variety of feed intakes. In this experiment, intake was restricted to 83, 90, 93 and 94% of ad libitum. Under current conditions, most feeders should continue to strive to maximize feed intake and performance by their cattle.

TABLE 7. CARCASS DATA, TRIAL 2[a]

Item	Treatment				SEM[b]
	Ad libitum	93%	85%	85+%	
Dressing percent	62.88	63.14	62.46	62.99	.51
Hot carcass wt, lb	695	693	700	692	7.38
Fat thickness, inches	.61	.58	.55	.55	.03
Marbling[c]	5.26	5.48	5.55	5.31	.10
Kidney, heart and pelvic fat, %	1.98	1.91	2.26	2.20	.17
Rib eye area, sq in	12.15	12.50	12.30	12.57	.16
Percent choice	69.21	78.71	81.19	67.77	11.23
Yield grade	3.18	2.96	3.04	2.93	.14

[a] Least-squares means adjusted to a common total NEg intake.
[b] Standard error of the mean.
[c] Small^{o} = 5.00; Modest^{o} = 6.00.

References

Owens, F. N., W. M. Sharp and D. R. Gill. 1984. Net energy calculation from feedlot performance data. Oklahoma Agr. Exp. Sta. MP-116:290.