EFFECT OF CONTROLLED FEED INTAKE ON PERFORMANCE OF FEEDLOT STEERS AND HEIFERS

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Story in Brief

Seventy two yearling steers (823 lb) and 80 heifers (723 lb) were used in two experiments to determine the effect of controlling feed intake on feedlot performance. In the steer experiment, animals were fed a high wheat diet either ad libitum or 85% of ad libitum. Daily feed intakes over the 149 day trial were 26.4 and 22.3 lb for ad lib and controlled steers. Controlled feeding reduced daily gains by 12.7, 4.5 and 7%, respectively during the first 56 days, next 84 days, and total trial. Daily gains for the trial averaged 3.00 and 2.79 lb for ad libitum and controlled steers. Efficiency of feed use was decreased by 4.8% over the first 56 days but improved by 14% over the next 84 days and improved overall by 8.9% with controlled feeding (8.80 vs 8.02 lb feed/lb gain). Feed plus yardage cost was reduced by 5.2% by controlled feeding (48.9 vs 51.6 -/lb). In the heifer experiment, animals were fed a high corn diet either ad libitum or 89% of ad libitum. Daily feed intakes during the 140 day trial averaged 21.3 and 18.9 lb for ad libitum and controlled heifers. Daily gains were reduced by 9.7% during the first 56 days but increased by 9.4% over the next 77 days. Over the total trial, gains were reduced by 3.1% with controlled feeding (3.58 vs. 3.47 lb/day). Efficiency of feed use was not affected during the first 56 days, but was improved by 19.8% during the next 77 days and improved overall by 8.7% (5.96 vs 5.44 lb feed/lb gain). Feed plus yardage cost of gain was reduced by 5.2% by controlled feeding (34.9 vs 36.8 -/lb).

(Key Words: Cattle, Feedlot, Controlled Feeding, Wheat, Corn.)

Introduction

Several recent studies have reported that feed efficiency of feedlot cattle can be improved by controlling feed intake. Zinn (1986) programmed feed intake of steers to a constant daily weight gain and observed a 4.3% improvement in efficiency of feed use and a 4.9% increase in the net energy value of the diet. Restricting feed intake to 92% and 96% of ad libitum improved feed efficiency by 2.5% and 3.2% in a Minnesota trial (Plegge et al., 1985). Plegge et al. (1986), in a follow up study, found improvements of 4.7% and 2.2% in feed conversion with restricted feeding at 92% and 96% of ad libitum, respectively. Feeding steers at 90% of ad libitum improved conversion ratio by 5.1% (Lofgreen, 1969). In contrast to these studies, others have found that restricted feeding (7 to 10%) decreased feed efficiency by approximately 1% and reduced gains by 8 to 11% (Garrett, 1979; Lofgreen et al., 1983).

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Potential reasons for improved feed efficiency include reduced fat deposition, reduced feed waste, increased diet digestibility, reduced animal activity and maintenance requirements. Reducing feed intake should not improve efficiency according to the net energy equations which precisely match feedlot results of cattle with ad lib access to feed. The objective of this study was to further evaluate the effect of controlled feeding on the performance of feedlot steers and heifers.

Materials and Methods

Steer Experiment

Seventy-two crossbred steers sired by Limousin bulls and out of Hereford/Angus/Brahman cows (0, 1/4 or 1/2 Brahman) were weighed on trial at Goodwell, Oklahoma on April 1, 1986. These steers had grazed winter wheat pasture at El Reno, Oklahoma since November, 1985. Prior to the start of the trial, the steers were blocked into three breed groups of 24 head each. Each breed group was further divided into four partially covered pens of six head each with a 2 x 2 factorial of treatments being randomly assigned to each group. Two dietary treatments, hard red winter wheat vs Arkan wheat, were provided either ad libitum or at 85% of ad libitum consumption. Results of the wheat comparison are discussed elsewhere in this publication.

This concentrate ration consisting of rolled wheat, cottonseed hulls, a pelleted supplement, and molasses was fed for the entire 149 day trial (Table 1). Dehydrated alfalfa pellets and cottonseed hulls were used to dilute the ration to 60 percent concentrate to start the

Table 1. Steer ration composition, dry matter basis.

Ingredient	Ration Sequence 1	2	3	4[a]
	------------- % -------------			
Rolled wheat (mill run or Arkan)	51	61	71	81.45
Cottonseed hulls	20	15	10	9.55
Alfalfa, dehy-pellets	20	15	10	-----
Molasses	4	4	4	4
Pelleted supplement	5	5	5	5
	Supplement Composition, % of DM			
Alfalfa meal	2.95			
Cottonseed meal	.50			
Calcium carbonate	.81			
Urea	.40			
Salt	.30			
Monensin, 60 g/lb	.02			
Vitamin A, 30000 IU/g	.01			
Tylan, 40 g/lb	.01			

[a]Formulated to contain 2.85 mcal ME/kg, 82.7 mcal NEm/cwt, 57.7 mcal NEg/cwt, .033 g monensin/kg, .01 g tylan/kg, 3300 IU vitamin A/kg, 13.5% crude protein, .78% potassium, .50% calcium and .38% phosphorus.

cattle on feed. These roughages were decreased sequentially in three steps until the cattle were on their final ration by 28 days on feed. All cattle were fed ad libitum for the first 21 days of the study. Amounts of feed offered to cattle being controlled were calculated from amounts consumed by pens with ad lib access to feed over the past 2 weeks.

Steers were weighed full on days 28, 56, 84 and 112, individually. On day 140, the steers were weighed by pen because some animals were too large for the individual scales. Steers were trucked 70 miles to Booker, Texas on day 149 of the trial (August 28, 1986) for slaughter, and carcass data were obtained. The data was analyzed using a general linear model with breed type, wheat type and feed treatment (ad libitum vs 85% of ad libitum) as main effects. All two-way interactions were included in the model. No significant interactions between wheat type and feed treatment were observed on any of the criteria evaluated, so only the main effects of feed treatment are reported in this paper.

Heifer Experiment

Eighty crossbred heifers of the same breed type as the steers were weighed on trial at Goodwell on April 10, 1986. These heifers had grazed winter wheat pasture at Goodwell since December, 1985. The heifers were blocked into three breed groups of 26 to 28 head each. Each breed group was further divided into two outside pens of either 13 or 14 head, with the two treatments (ad libitum feeding vs 89% of ad libitum) being randomly assigned within each breed group.

Table 2. Heifer ration composition, dry matter basis.[a]

Ingredient	Ration Sequence				
	1	2	3	4	5[a]
	%				
Corn, whole shelled	52.55	62.55	72.55	82.55	87.55
Cottonseed hulls	20	15	10	5	5
Alfalfa, dehy-pellets	20	15	10	5	-----
Pelleted supplement	7.45	7.45	7.45	7.45	7.45
	Supplement Composition, % of DM				
Cottonseed meal			2.93		
Soybean meal			1.75		
Molasses			.28		
Calcium carbonate			1.10		
Salt			.30		
Urea			.45		
Potassium chloride			.37		
Dicalcium phosphate			.20		
Vitamin A, 30000 IU/g			.02		
Monensin, 60 g/lb			.03		
Tylan, 40 g/lb			.01		
Trace mineral			.01		

[a]Formulated to contain 3.15 mcal ME/kg, 95.9 mcal NEm/cwt, 61.8 mcal NEg/cwt, .033 g monensin/kg, .01 g tylan/kg, 3300 IU vitamin A/kg, 11.7% crude protein, .65% potassium, .50% calcium and .34% phosphorus.

Heifers were fed a complete whole shelled corn concentrate ration for the 140 day trial. Roughage content of the diet (dehydrated alfalfa pellets and cottonseed hulls) were decreased sequentially from 40 to 30 to 20 to 10 to 5% over 28 days (Table 2). All cattle were fed ad libitum for the first 21 days on feed. Amounts of feed offered to cattle being controlled were calculated from amounts offered to ad libitum pens the previous week. Heifers were weighed full at the start of the trial and on days 28, 56, 84 and 112. At day 133, cattle were weighed by pen. The heifers were trucked to Booker, Texas on day 140 of the trial for slaughter. The data was analyzed using a general linear model with breed and feed treatment as main effects.

In both of the experiments, weights are reported on a full basis while gains and efficiencies were calculated using a 4% pencil shrink. Gains and efficiencies for each trial were calculated from hot carcass weights assuming that dressing percent was 62.

Results and Discussion

Carcass adjusted daily gains of the steers (Table 3) were reduced by 7% with controlled feeding (3.00 vs 2.79 lb/day) and live weight gains were reduced by 8.1% (P<.01). During the first half of the feed-

Table 3. Effect of controlled feeding on steer performance.

	Ad libitum	Controlled Fed	SEM
Number of steers	36	36	
Number of pens	6	6	
Weight, lb:			
Initial	824	823	1.1
56 days	1037	1014	6.0
112 days	1212	1194	8.7
140 days	1292[a]	1258[b]	1.7
Daily gains, lb:			
0-56	3.07[e]	2.68[f]	.09
57-140	2.91	2.78	.07
0-140, live	2.98[a]	2.74[b]	.01
0-149, carcass	3.00	2.79	.08
Daily feed, lb DM:			
0-56	17.96	16.44	.42
57-140	31.53[a]	25.80[b]	.08
0-140, live	26.10[a]	22.06[b]	.13
0-149, carcass	26.36[a]	22.29[b]	.12
Feed/gain:			
0-56	5.88	6.16	.18
57-140	10.83[d]	9.31[c]	.23
0-140, live	8.78[d]	8.06[c]	.07
0-149, carcass	8.80	8.02	.23
Net energy, mcal/cwt:			
Maintenance	79.34	87.38	1.75
Gain	52.32[e]	58.14[f]	1.17
Metabolizable energy, mcal/kg	2.77	2.96	.06

[abcdef]Means in the same row with different superscripts differ (a,b = P< .01, c,d = P<.05, e,f = P<.10).

ing period, gains were decreased by 12.7% (P<.10) by controlled feeding, whereas this reduction was only 4.5% during the last half of the study. Restriction in feed intake reduced intake over the entire trial to an average of 84.6% of ad libitum (P<.01). Intake was reduced by 8.5% during the first half of the trial and by 18.2% (P<.001) during the second half. Feed efficiency was reduced by 4.8% in the first half of the trial (5.88 vs 6.16 lb feed/lb gain) but improved by 14% (P<.05) during the second half of the trial by controlled feeding. For the entire 149 day trial, feed conversion was improved by 8.9% with controlled feeding (8.80 vs 8.02). The estimated ME value of the diet increased by 6.9% with controlled feeding (2.77 vs 2.96 mcal/kg). The percent of steers grading choice (Table 4) was reduced from 61.1% to 41.7% by controlled feeding (P<.02) which is presumably due to the lighter slaughter weight.

Controlled feeding of the heifers (Table 5) reduced daily gains by 9.7% (P<.10) during the first half of the feeding period, but actually increased gains by 9.4% (P<.05) over the second half of the trial. On a carcass adjusted basis, gains were decreased by 3.1% by controlled feeding (3.58 vs 3.47 lb/day). On the average, feed intake was reduced by 11.2% (P<.01) over the 140 day trial (21.29 vs 18.90 lb/day), being decreased by 10.3% (P<.05) and by 11.5% (P<.01) in the first half and second half of the trial. Controlled feeding did not alter feed efficiency during the first half of the trial, but improved it by 19.8% (P<.05) over the second half of the trial (10.13 vs 8.12 lb feed/lb gain). Efficiency was improved by 8.7% (P<.10) over the entire 140 day trial (5.96 vs 5.44). Controlled feeding caused no statistical changes in any of the carcass parameters measured (Table 6) though, as with steers, the percent of heifers grading choice tended to be reduced (38 vs 47%) by controlled feeding.

In both trials, feed consumption increased as the feeding period progressed. For typical feedlot cattle, one would expect feed intake to peak and plateau between 60 to 100 days on feed and then decline as cattle approach slaughter weight. It has been suggested that this decline in intake is related to body composition (Hyer et al., 1986) so that when empty body fat reaches a level of about 32%, feed intake decreases. In these trials, perhaps body fat never reached a level of 32%. Fat thickness and percent of animals grading choice were low in both trials.

With both the steers and the heifers, controlled feeding reduced feed efficiency during the first half of the feeding period but improved efficiency during the second half of the feeding period. This suggests that controlling intake only during the second half of a feeding period

Table 4. Effect of controlled feeding on steer carcass parameters.

	Ad Libitum	Controlled Fed	SEM
Carcass wt, lb	788	768	8.4
Dressing percent	63.5	63.6	.65
Rib eye area	13.86	13.62	.22
KHP, %	2.24	2.21	.05
Fat thickness, in	.34	.31	.02
Marbling score[a]	12.53	12.11	.26
Percent choice	61.1[b]	41.7[c]	2.0
Yield	2.36	2.28	.09

[a]12=slight plus, 13=small minus.
[bc]Means in the same row with different superscripts differ (P<.05).

Table 5. Effect of controlled feeding on heifer performance.

	Ad Libitum	Controlled Fed	SEM
Number of heifers	40	40	
Number of pens	6	6	
Weight, lb:			
Initial	727^f	718^e	2.0
56 days	979^d	947^c	3.3
112 days	1121^f	1104^e	3.0
133 days	1158	1142	5.1
Daily gains, lb:			
0-56	4.33^f	3.91^e	.09
57-133	2.23^c	2.44^d	.04
0-133, live	3.11	3.06	.05
0-140, carcass	3.58	3.47	.06
Daily feed, lb DM:			
0-56	19.80^d	17.76^c	.33
57-133	22.16^b	19.62^a	.10
0-133, live	21.17^b	18.83^a	.15
0-140, carcass	21.29^b	18.90^a	.15
Feed/gain:			
0-56	4.58	4.56	.18
57-133	10.13^d	8.12^c	.31
0-133, live	6.82^f	6.16^e	.17
0-140, carcass	5.96^f	5.44^e	.13
Net energy, mcal/cwt:			
Maintenance	108.09^e	119.93^f	2.45
Gain	68.69^e	73.62^f	1.21
Metabolizable energy, mcal/kg	3.37^e	3.58^f	.055

[abcdef]Means in the same row with different superscripts differ (a,b = P< .01, c,d = P<.05, e,f = P<.10).

Table 6. Effect of controlled feeding on heifer carcass parameters.

	Ad Libitum	Controlled Fed	SEM
Carcass wt, lb	743	729	4.7
Dressing percent	66.8	66.5	.45
Rib eye area	13.83	13.54	.63
KHP, %	2.61	2.51	.14
Fat thickness, in	.44	.40	.06
Marbling score[a]	11.9	11.5	.62
Percent choice	47.3	37.7	14.2
Yield	2.52	2.45	.05

[a]11=average slight, 12=slight plus.

might prove most economical. Controlling intake to 85% of ad libitum appears to be too severe because it reduced gains by 7%. Controlling intake to 89% of ad libitum with the heifers improved feed conversion without appreciably reducing gains. Controlled feeding improved feed efficiency and calculated ME with both the high wheat diet and the whole high corn diet.

Table 7. Summary of controlled feeding research.

Source	Sex, Calves or Yearlings	N	Intake Restriction, %	Gain Reduction %	Feed Eff. Improvement %	Change in Diet ME, %	Change in % Choice units	Cost Savings %
Lofgreen 1969	SC	12	13.6	9.0	5.1	0.7	-25.0	-2.1
Garrett 1979	SC	43	6.7	7.6	-1.3	3.7		-3.1
Lofgreen 1983	SC	88	10.4	11.4	-1.0	1.0		-1.0
Plegge 1985	SY	24	7.3	5.0	2.5	1.5		0.0
Plegge 1985	SY	24	4.5	1.6	3.2	1.9		1.6
Plegge 1986	SY	16	8	3.6	4.7	3.4		2.3
Plegge 1986	SY	26	4.6	2.9	2.2	1.9		0.6
Zinn 1986	SC	90	5.8	0.0	4.3	3.6		2.6
Hicks 1986	SY	36	15	8.0	8.9	6.8	-19.4	5.2
Hicks 1986	HY	40	11	3.1	8.7	6.2	-9.6	5.2

In summary, results of these two trials would suggest that controlled feeding of feedlot cattle can improve efficiency. Several important questions remain unanswered. First, what is the most desirable method of controlling intake? When should one control intake (early or late in a feeding period)? What is the optimum level of restriction? What type of animals respond best? A review of the research conducted on controlled feeding would suggest that yearlings respond more favorable than calves (Table 7). Both of the studies which have shown controlled feeding to reduce feed efficiency have been with calves. Programming gain to a specific rate would be the simplest method to apply under feedlot conditions. Besides reducing labor for calling feed, controlling intake will aid bunk management and cleaning, may reduce feed truck mileage by feeding in a specific sequence and should permit one to program gains to meet slaughter dates of futures contracts. More research is needed before this practice can be recommended.

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