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ENVIRONMENTAL EFFECTS ON LIMIT-FED FEEDLOT FINISHING DIETS

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Summary

Ninety-six crossbred yearling steers were allotted to either ad libitum or 93% of ad libitum intake treatments in a 117-day winter finishing trial. Intake restriction began once the 93% treatment group was started on its finishing diet. Finishing diets were formulated to result in similar absolute intakes of nutrients and feed additives. Restricted treatment dry matter intake was lower than ad libitum as intended ($P<.05$), but average daily gain was also less, 3.71 and 3.50 lb per day ($P<.05$) and resulted in similar feed/gain, 6.01 and 6.07 ($P>.82$). These results are in contrast to two previous trials conducted during summer and mild winter/spring conditions and suggest that cold stress may affect the response to limit-feeding of feedlot finishing diets.

(Key Words: Yearling steers, Limit-feeding, Environment.)

Introduction

Ad libitum feed intake has generally been thought to result in maximum feed efficiency because it maximizes rate of gain and "dilutes" feed necessary to cover maintenance requirements. However, Oklahoma and California research demonstrated that slight restrictions (90 to 95% of ad libitum) may, in some cases, improve feed efficiency without appreciably decreasing rate of gain. Results from Minnesota, Iowa and South Dakota were inconsistent or negative and may have been due to an interaction between environmental conditions and reduced heat increment. Subsequent research in South Dakota demonstrated that rate of gain can be maintained with a 7% restriction in feed intake with yearling steers fed in summer/fall or mild winter/spring conditions. However, because of the mild conditions of the second trial, it was still unknown if the response to limit-fed finishing diets would be present in more typical (severe) winter feeding conditions.

The objective of this study was to collect additional data on limit-feeding of finishing diets to yearling steers in winter. Results from the limit-feeding studies conducted over the previous 2 years are also summarized.

Materials and Methods

Ninety-six mixed crossbred, yearling steers were selected from a larger group and assigned within weight block to either ad libitum or restricted treatments with four pens per treatment and 12 head per pen. Feeding management of the steers was the same as in two previous trials reported in 1990. Ad libitum cattle had unlimited access to feed throughout the trial. Finishing diet intake of the restricted steers was limited to 93% of the previous 7-day average of the ad libitum treatment within weight block. The finishing diets were formulated such that absolute intakes of protein, calcium, phosphorus, potassium, supplemental trace minerals, vitamin A and feed additives (monensin and tylosin) were the same across treatments (Table 1).

The cattle were vaccinated (IBR, BVD, BRSV, Lepto, 7-way clostridial), treated with Ivermectin,

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TABLE 1. STEP-UP AND FINISHING DIETS FED TO AD LIBITUM AND RESTRICTED CATTLE

Ingredient	Diet					
	1	2	3	4	5[a]	5[b]
	%					
Rolled corn	53.7	58.8	66.3	73.8	80.8	80.0
Oat hulls				7.5	8.0	8.0
Molasses	4.0	4.0	4.0	4.0	4.0	4.0
Alfalfa	37.9	30.0	22.5	7.5		
Supplement	4.4	7.2	7.2	7.2	7.2	8.0
Analysis (dry matter basis)						
Dry matter, %	85.9	86.2	86.4	87.1	88.0	88.0
Crude protein, %	13.0	14.2	13.6	12.1	11.5	12.3
Net energy, Mcal/cwt						
Maintenance	82.8	85.5	88.7	90.5	93.4	93.0
Gain	53.8	56.3	59.0	59.3	61.8	61.4
Calcium, %	.87	.91	.81	.61	.50	.54
Phosphorus, %	.55	.34	.35	.35	.35	.38
Potassium, %	1.25	1.17	1.07	.89	.80	.86
Vitamin A, IU/lb DM	3295	2119	2119	2119	2119	2283
Monensin, g/T DM	12.4	30.5	30.5	30.5	30.5	32.9
Tylosin, g/T DM	11.2	7.6	7.6	7.6	7.6	8.2

[a] Ad libitum.
[b] Restricted.

implanted with Synovex-S and ear tagged upon arrival at the feedlot. They were weighed on and off test after a 16-hour removal of feed and water.

Daily gains (ADG) were analyzed as a random design using initial weight:height ratio as a covariate. Feed dry matter intake (DMI) and feed efficiency (F/G) were analyzed as a randomized block design. Weather data were collected about 600 feet south of the feedlot in an unprotected area. The feedlot pens were protected by a shelter belt to the north and west and each pen contained a windbreak. The pens were also bedded with straw as needed.

Results and Discussion

Test dates and weather data for the previous (Trials 1 and 2) and the most recent (Trial 3) studies are presented in Table 2. Average temperature was 12° F lower in Trial 3 than 2 and was close to the 30-year average of 22° F for this part of the state. This difference was somewhat less when expressed as wind chill, but this must be evaluated with caution because the weather instruments were unprotected, whereas the cattle had access to windbreaks. The data do indicate that the weather during Trial 3 was colder than during Trial 2 and more typical of what can be expected for the southeast portion of South Dakota.

Initial and final weights and days on feed in Trial 3 were similar to those in Trials 1 and 2 (Table 2). As with previous results, overall DMI was lower for the restricted treatment group ($P<.05$), averaging 95.8% of ad libitum. Restricted treatment DMI was higher than 93% because of ad libitum intake of the step-up rations. However, unlike the previous trials, ADG was .21 lb per day lower for the restricted steers ($P<.05$). The combined changes in DMI and ADG resulted in virtually identical F/G ($P>.82$). This is in contrast to consistent trends of improved F/G (5.3% and 6.9%) due to restriction in Trials 1 and 2 resulting from significantly lower DMI but unchanged ADG. No difference between treatments in dressing percent was found in Trial 3 ($P>.10$). However, carcass weight and rib eye area were greater for the ad libitum-fed steers ($P<.05$). They were 763 lb, 744 lb, 13.12 $in.^2$ and 12.40 $in.^2$ for ad libitum and restricted steers, respectively.

Although the trials could not be pooled for statistical analysis, consistency in the results of Trials 1 and 2 suggest that the response to feeding level is not affected by source of cattle. For this reason and since all other management factors were similar among trials, environmental differences seem the likely cause for the different response in Trial 3. While the differences in temperature and wind chill do not seem large between Trials 2 and 3 compared to seasonal changes, it must be acknowledged that temperature and wind are only two factors that contribute to the total cooling power of the environment. Other factors such as precipitation and mud affect the insulation value of the hair coat and, as a result, the temperature at which an animal will be cold stressed (lower critical temperature, LCT). Data describing these factors were not available. Additionally, Iowa feedlot data have shown the greatest correlation between yearling cattle performance and temperature using degree-days below 19° F. It may have been that conditions in Trials 2 and 3 were only slightly above and below the LCTs for these cattle, resulting in different responses across a small change in temperatures. Degree-days below 19° F were 1665 and 1819 for Trials 2 and 3, respectively.

The results from Trials 1, 2 and 3 indicate that yearling steer ADG can be maintained with a slight restriction of high concentrate, finishing diet DMI (93%), but that cold stress may affect the response. As a result, limit-feeding of finishing diets may be appropriate in spring, summer and fall but not winter in South Dakota. Since pair-feeding is not feasible in commercial feedlots, additional work is necessary to devise practical means of implementing limit-feeding.

TABLE 2. WEATHER AND PERFORMANCE DATA FOR YEARLING STEERS FED DURING THREE LIMIT-FEEDING TRIALS

	Trial 1		Trial 2		Trial 3	
Item	Ad libitum	Restricted	Ad libitum	Restricted	Ad libitum	Restricted
Dates on test	7-13-89		1-11-90		11-8-90	
Dates off test	11-8-89		5-8-90		3-5-91	
Avg temperature, F	62		37		25	
Avg wind speed, mph	6.8		8.5		6.5	
Avg wind chill, F	--		13		7	
No. steers	36	36	36	36	48	47
Days on feed	118	118	117	117	117	117
Initial wt, lb	823	817	851	851	808	805
Final wt, lb	1259	1247	1219	1225	1242	1215
Daily gain, lb	3.70	3.64	3.14	3.20	3.71	3.50[b]
Dry matter intake, lb	22.23	20.73[a]	21.92	20.81[a]	22.26	21.33[b]
Feed/gain	6.03	5.71	7.00	6.52	6.01	6.07

[a] Significant within trial ($P<.001$).
[b] Significant within trial ($P<.05$).