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RESPONSE OF YEARLING CATTLE TO LIMIT-FED FINISHING DIETS IN DIFFERENT SEASONAL ENVIRONMENTS

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Summary

Two trials were conducted to evaluate limit-feeding of finishing diets to yearling steers in different seasonal environments. In Trial 1, 72 yearling steers were fed (1) ad libitum or (2) 93% of ad libitum (restricted) from July through early November. Trial 2 was conducted from January through early May with a similar group of steers. Weather data collected at the feedlot indicated that the weather during Trial 1 was similar to the 30-year average (Trial 1 average air temperature = 62 °F), but the weather during Trial 2 was 10 °F warmer than typical (average air temperature = 37 °F). In both trials, dry matter intakes were lower for restricted than controls as intended ($P<.001$), but average daily gains did not differ ($P>.10$). This resulted in numerically improved feed/gain but only approached significance in Trial 1 ($P=.14$). Carcass characteristics were not affected by treatment ($P>.10$) with the exception of dressing percent in Trial 1, but this difference was not found in Trial 2. Limit-feeding of finishing rations to yearling steers tended to improve feed/gain in warm summer as well as moderate winter-spring environments.

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

Introduction

It has been widely considered in the cattle feeding industry that feed efficiency is maximized in finishing cattle by increasing feed intake which maximizes rate of gain and "dilutes" maintenance energy requirements (i.e., the greater the energy intake, the smaller the percentage required for maintenance). Decreased digestibility that also results from higher feed intake is more than offset. In the last several years, university research from Oklahoma and California has shown that slight restriction of feed intake (90 to 95% of ad libitum) may in some cases improve feed efficiency without appreciably decreasing rate of gain. This, in addition to practical benefits such as improved bunk management and reduced feed wastage, could make limit-feeding of finishing diets a viable management option once questions such as how to determine the degree of restriction in commercial feeding conditions and the appropriate nutrient and feed additive levels have been answered.

However, South Dakota, Minnesota and Iowa research has shown that responses to limit-feeding are not consistent, and the reasons are unknown. The inconsistencies may be due in part to variations in environment. A reduction in dry matter intake not only reduces energy intake but also the heat produced as a consequence of consumption, digestion and metabolism. Reduced heat production may increase the lower critical temperature (the temperature below which an animal may be stressed by cold) by 6 to 13 °F, potentially decreasing or even negating the improvements in efficiency.

The objective of this study was to determine whether limit-feeding would be effective in yearling cattle fed during seasons having substantially different environmental conditions.

Materials and Methods

In Trial 1, a group of 199 crossbred, yearling steers (predominantly Charolais, Simmental and Limousin) were vaccinated (IBR, BVD, BRSV, Lepto, 7-way clostridial), treated with invermectin, implanted with Synovex-S, ear tagged and weighed shortly after arrival at the feedlot. Seventy-two head were selected from these, blocked by weight and randomly assigned to two treatments with four pens per treatment, 9 head per pen. The treatments were (1) ad libitum (cattle had unlimited access to feed) and (2) restricted. The amount of feed offered to treatment 2 was adjusted daily and restricted to 93% of the previous 7-day average for the corresponding control pen within weight block. This approach greatly reduced day-to-day variation in intake for the restricted group. The restriction was begun once the cattle were started on their finishing diets. Step-up diets were fed ad libitum. The finishing diets were formulated such that absolute

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intakes of protein, calcium, phosphorus, potassium, supplemental trace minerals, vitamin A and feed additives were the same across treatments (Table 1). The intention was to restrict only dry matter and energy intake. The steers were weighed on and off test after a 16-hour shrink off feed and water. The procedures of Trial 1 were repeated in Trial 2 with 72 steers of similar breeding selected from a group of 172 head.

The data from Trials 1 and 2 were statistically analyzed separately as a randomized block design because of the confounding between season and source of cattle.

The weather instruments were mounted approximately 6 feet above the ground in an area unprotected by windbreaks, trees or buildings. The feedlot was located approximately 600 feet north of the weather instruments and protected on the west and north by a shelter belt and each pen contained a windbreak. The pens were also bedded with straw during Trial 2.

TABLE 1. STEP-UP AND FINISHING DIETS FED TO CONTROL 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, %						
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] Control.
[b] Restricted.

Results and Discussion

Weather data collected during Trials 1 and 2 are presented in Table 2. Weather during Trial 1, conducted from July through early November, 1989, was almost identical to the 30-year average for the area. However, weather during Trial 2, conducted from January through early May, 1990, was approximately 10 °F warmer than average. The average windchill temperature during Trial 2 based on the weather data was 13 °F and was as low as 4 °F during January and February. The pens were somewhat protected from direct wind, however, so that windchill temperatures to which the cattle were exposed were likely higher.

Performance data for Trial 1 (Table 3) indicated no differences in initial or final weights or average daily gain (ADG). Dry matter intake (DMI) was significantly lower ($P<.001$) for the restricted steers, as intended, and averaged 93.3% of the controls for the entire feeding period which included the step-up rations that were fed ad libitum. Because DMI was lower but ADG was unchanged, the feed/gain (F/G) ratio was numerically lower and approached statistical significance ($P=.14$).

The results of Trial 2 reflect a similar response to limit-feeding. Initial and final weights and ADG were similar across treatments, while restricted DMI averaged

TABLE 2. WEATHER DATA FOR TRIALS 1 AND 2

Item	Trial 1 7-13-89 to 11-8-89	Trial 2 1-11-90 to 5-8-90
Avg daily high temperature, °F	75	49
Avg daily low temperature, °F	49	25
Avg hourly temperature, °F	62	37
Avg relative humidity, %	67	62
Avg wind speed, mph	6.8	8.5

[a] Data were collected at the feedlot using weather instrumentation mounted approximately 6 feet above the ground and unprotected by windbreaks, trees or buildings.

TABLE 3. PERFORMANCE DATA FOR YEARLING STEERS FED DURING DIFFERENT SEASONS

Item	Trial 1			Trial 2		
	Ad libitum	Restricted	SE	Ad libitum	Restricted	SE
No. steers	36	36		36	36	
Days on feed	118	118		117	117	
Initial wt, lb	823	817	4.4	851	851	4.2
Final wt, lb	1259	1247	13.5	1219	1225	12.6
Daily gain, lb	3.70	3.64	.10	3.14	3.20	.10
Dry matter intake, lb	22.23	20.73[a]	.15	21.92	20.81[a]	.07
Feed/gain	6.03	5.71	.14	7.00	6.52	.29

[a] Treatment effect within trial significant (P<.001).

94.95% of controls (P<.001). As in Trial 1, overall restriction was higher than 93% because of DMI while on the step-up rations. As a result of lower DMI and similar ADG, F/G was numerically lower but not significantly different (P=.28).

No differences in carcass data were found due to treatment in either trial (Table 4) with one exception. Dressing percent was lower (P<.10) for the restricted steers in Trial 1. This is contrary to what one would expect if restriction reduced gut fill. The steers were shrunk 16 hours prior to initial and final weighing to reduce this potential effect on dressing percent. This difference was not found in Trial 2.

It appears from these two trials that a small restriction in DMI can result in similar ADG and may thereby improve F/G in yearling steers. This seems true even in the moderate winter-spring conditions present in Trial 2. Determining if limit-feeding will work under more normal (adverse) conditions will require additional study, but these results suggest that limit-feeding, at the very least, could be a viable management option for cattle fed during the spring, summer or fall in South Dakota.

TABLE 4. CARCASS DATA FOR YEARLING STEERS FED DURING DIFFERENT SEASONS

Item	Trial 1			Trial 2		
	Ad libitum	Restricted	SE	Ad libitum	Restricted	SE
Carcass wt, lb	785	769	9.2	753	759	9.7
Dressing percent	62.39	61.71[a]	.263	61.99	61.93	.267
Fat thickness, in.	.47	.46	.027	.46	.46	.023
Rib eye area, $in.^2$	13.37	13.13	.228	13.23	13.14	.195
Yield grade	2.86	2.83	.116	2.73	2.74	.105
Marbling score[b]	11.11	11.36	.661	13.20	12.72	.725

[a] Treatment effect significant ($P<.10$).
[b] 10 = high select; 11 = low choice.